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Revision 1

Health and Safety Plan for the VES-SFE-20 Hot Waste Tank System

Idaho Completion Project

Bechtel BWXT Idaho, LLC

January 2004

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Revision 1
Project No. 23052

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Idaho Completion Project
Clean/Close INTEC
Idaho Falls, Idaho 83415

Prepared for the
U.S. Department of Energy
Assistant Secretary for Environmental Management
Under DOE/NE Idaho Operations Office
Contract DE-AC07-99ID13727

ABSTRACT

This health and safety plan establishes procedures and requirements used to eliminate or minimize health and safety risks to personnel performing remedial tasks within the VES-SFE-20 Hot Waste Tank Project area located within the Idaho Nuclear Technology and Engineering Center at the Idaho National Engineering and Environmental Laboratory. This plan has been prepared to meet Occupational Safety and Health Administration standards contained in the "Hazardous Waste Operations and Emergency Response Requirements" (29 CFR 1910.120/1926.65).

The operational safety basis for VES-SFE-20 Project remedial actions is further evaluated in a company hazard assessment document. The unreviewed safety question process will be used to evaluate additional operations in accordance with company policies and procedures.

This plan contains the assessment and associated mitigation of safety, health, and radiological hazards for conducting remedial activities within the VES-SFE-20 Hot Waste Tank Project area. Safety, health, and radiological professionals assigned to support this project will use this health and safety plan as the basis for planning and hazard mitigation. Additional hazard controls and mitigation measures will be further defined based on project-specific conditions, and changes to this plan, and associated work control documents should be made as appropriate.

The Clean/Close Idaho Nuclear Technology and Engineering Center Subproject 6 health and safety officer will determine the most appropriate hazard control and required mitigation measures based on site-specific conditions and will make changes to this document as appropriate.

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ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
ACM	asbestos-containing material
AL	Occupational Safety and Health Administration action limit
ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
BBWI	Bechtel BWXT Idaho, LLC
CAM	continuous air monitor
CERCLA	Comprehensive Environmental, Response, Compensation and Liability Act
CFR	*Code of Federal Regulations*
CPR	cardiopulmonary resuscitation
CRC	contamination reduction corridor
CRZ	contamination reduction zone
CWA	controlled work area
dBA	decibel A-weighted
DOE	U.S. Department of Energy
EDF	engineering design file
EZ	exclusion zone
FECF	Fuel Element Cutting Facility
FTL	field team leader
GFCI	ground fault circuit interrupter
GI	gastrointestinal
H&R	hoisting and rigging
HASP	health and safety plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	high-efficiency particulate air

HSO	health and safety officer
IARC	International Agency for Research on Cancer
ICDF	INEEL CERCLA Disposal Facility
IDLH	immediately dangerous to life or health
IDW	investigation-derived waste
IH	industrial hygienist
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
ISMS	Integrated Safety Management System
JSA	job safety analysis
LEL	lower exposure limit
LO/TO	lock out and tag out
MCP	management control procedure
MSDS	material safety data sheet
NFPA	National Fire Protection Association
NIOSH	National Institute of Occupational Safety and Health
OMP	Occupational Medical Program
OSHA	Occupational Safety and Health Administration
OU	operable unit
PEL	permissible exposure limit
PEW	process equipment waste
PMT	project management team
PPE	personal protective equipment
PRD	program requirements documents
RadCon	Radiological Control
RCRA	Resource Conservation and Recovery Act

RCT	radiological control technician
RW	radiological worker
RWP	radiological work permit
SCBA	self-contained breathing apparatus
SFE	Storage Facility Exterior
SP	subproject
STR	subcontractor technical representative
SWP	safe work permit
TLV	threshold limit value
TPR	technical procedure
TRAIN	Training Records and Information Network
TWA	time-weighted average
UV	ultraviolet light
VES	vessel
VPP	Voluntary Protection Program
WCC	Warning Communications Center
WMP	waste management plan

Health and Safety Plan for the VES-SFE-20 Hot Waste Tank System

1. INTRODUCTION

This health and safety plan (HASP) identifies health and safety hazards and requirements used to eliminate or minimize hazards during remedial actions including the removal, characterization, treatment (as necessary), and disposal of the Vessel (VES) Storage Facility Exterior (SFE) -20 tank, sediment, vault, access way, pump pit, and ancillary piping at CPP-642, and underlying contaminated soils, in accordance with Waste Area Group 3 remedial action objectives. The VES-SFE-20 is located adjacent to CPP-603 inside the fence at the Idaho Nuclear Technology and Engineering Center (INTEC) at the Idaho National Engineering and Environmental Laboratory (INEEL). This HASP was written to meet requirements of the Occupational Safety and Health Administration (OSHA) *Code of Federal Regulations* (CFR) standard, "Hazardous Waste Operations and Emergency Response" (HAZWOPER) (29 CFR 1910.120/1926.65). In addition, the safety basis for VES-SFE-20 remedial activities will be evaluated using the unreviewed safety question process in accordance with applicable company documents and procedures.

1.1 Purpose and Applicability

This HASP addresses VES-SFE-20 Project hazards and associated mitigation of those hazards based on remedial actions to be completed at the VES-SFE-20 Project site. This HASP will be used in conjunction with other work control documents (e.g., job safety analyses [JSAs] and applicable company policies and procedures) to further define project hazards, mitigation, and procedural requirements. This HASP was reviewed in accordance with Management Control Procedure (MCP) -240, "ER/D&D&D Operational Review Board Process." The Clean/Close INTEC Subproject (SP) 6 health and safety officer (HSO), in conjunction with the field team leader (FTL) and the INTEC environment, safety, health, and quality assurance manager or designee, will review the HASP to ensure its effectiveness and suitability throughout the project and revise the plan if necessary. The Clean/Close INTEC SP-6 HSO shall be included on all document action requests (Form 412.11) to revise this HASP.

The VES-SFE-20 Project activities were reviewed in accordance with applicable company policies and procedures, and the project was categorized as a low-hazard activity requiring an auditable safety analysis. Technical procedures (TPRs), JSAs, and other appropriate work control process evaluations will be conducted to ensure operations are conducted in compliance with the auditable safety analysis. All VES-SFE-20 Project activities will fall within the INTEC facility authority jurisdiction.

This HASP governs all remedial activities of the VES-SFE-20 hot waste tank system performed by personnel of Bechtel BWXT Idaho, LLC (BBWI), subcontractors to BBWI, and employees of other companies or U.S. Department of Energy (DOE) laboratories.

1.2 INEEL Site Description

The INEEL is a U.S. government-owned test site managed by DOE. It is located in southeastern Idaho, 51.5 km (32 mi) west of Idaho Falls (see Figure 1-1), and encompasses approximately 2,305 m^2 (890 mi^2) of the northeastern portion of the Eastern Snake River Plain.

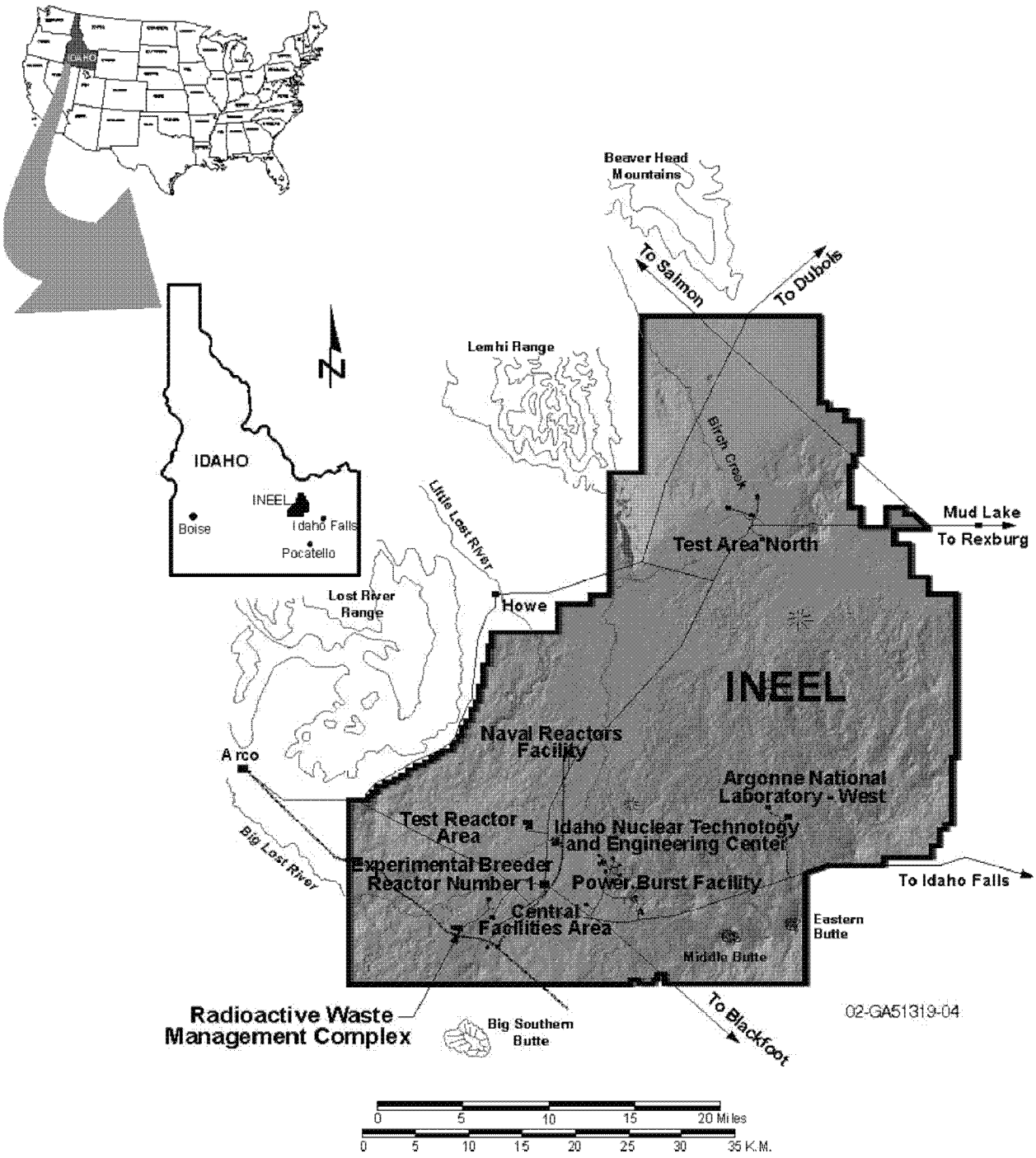


Figure 1-1. Map of the INEEL showing INTEC and other major Site facilities.

1.3 INTEC Site Description

The INTEC, formerly known as the Chemical Processing Plant, is located in the south-central portion of the INEEL (see Figure 1-2) and commenced operations in 1952. Historically, the INTEC has been a uranium reprocessing facility for both defense projects and research while also acting as a storage

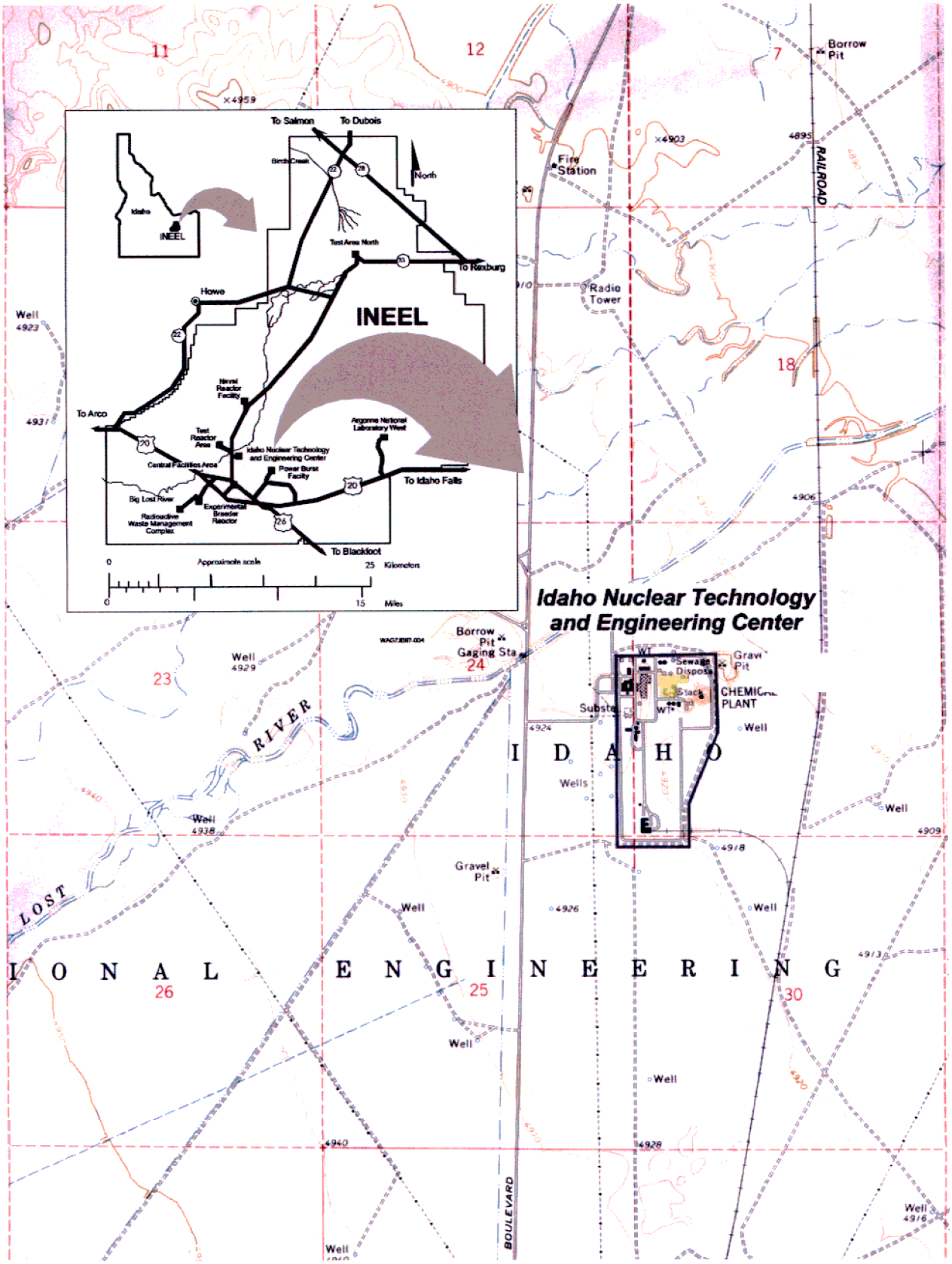


Figure 1-2. Map of INTEC at the INEEL.

facility for spent nuclear fuel. Irradiated defense nuclear fuels were reprocessed to recover unused uranium. Liquid waste generated from these activities was either stored at the INTEC Tank Farm for treatment at the calcining facility or disposed of in the INTEC injection well, CPP-23. After fuel dissolution and extraction, the liquid waste was calcined, and the resultant granular solids were subsequently stored in stainless steel bins. Depending on the type of fuel reprocessing used, several types of high-level radioactive liquid waste have been produced at INTEC. A phase-out of INTEC reprocessing activities began in 1992 including fuel dissolution, solvent extraction, and product denitrification. The VES-SFE-20 tank vault and its associated pump house (CPP-642) are located east of CPP-603 near the south perimeter of INTEC (see Figure 1-3).

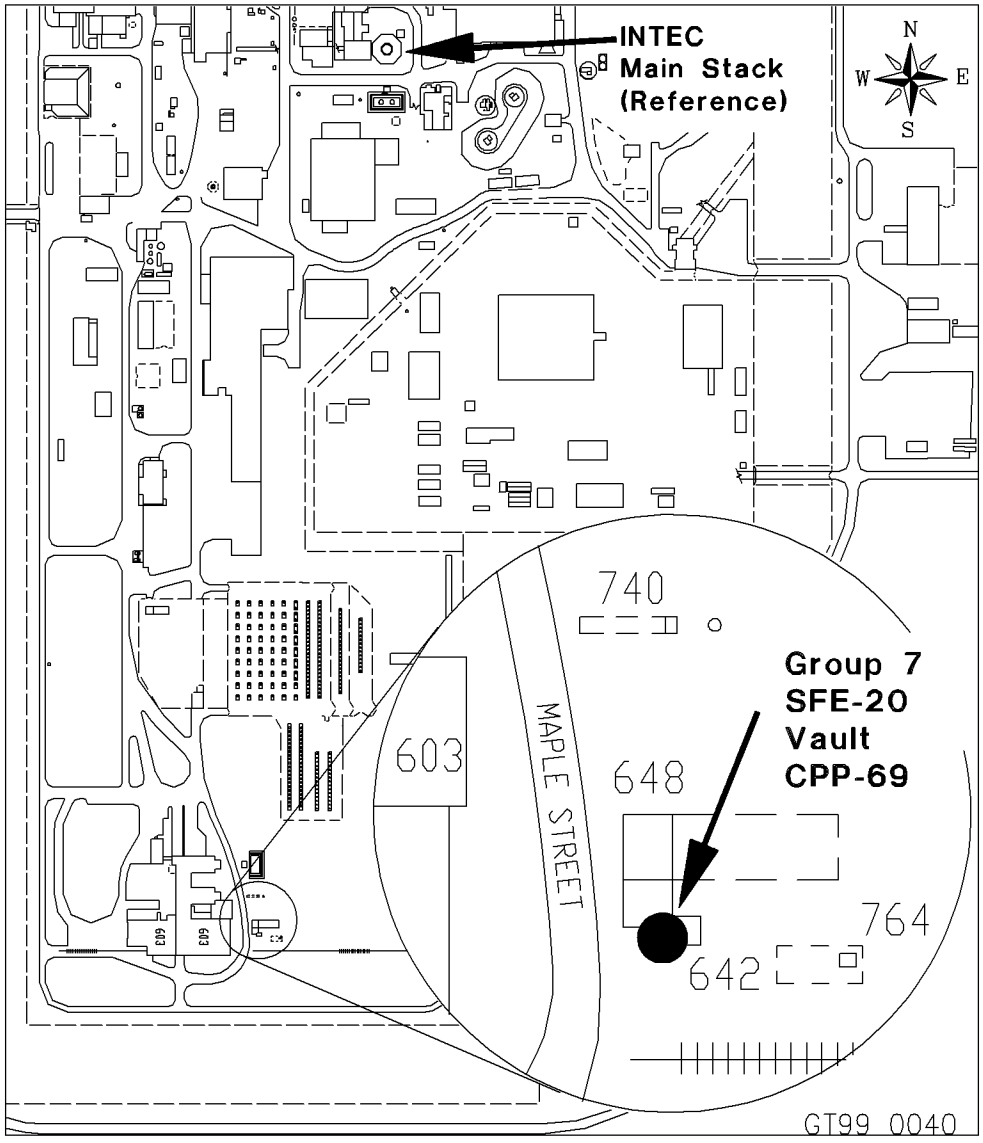
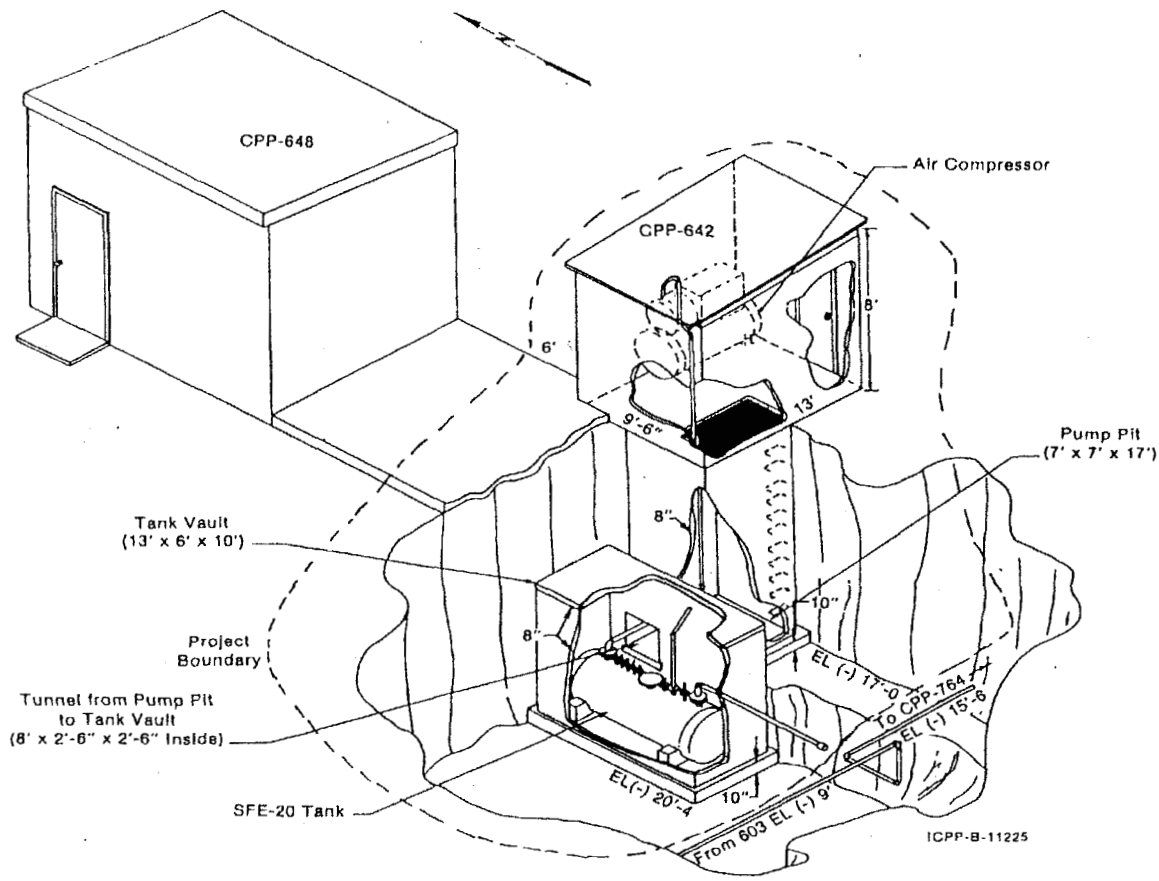


Figure 1-3. Location of the VES-SFE-20 tank at INTEC.

1.4 VES-SFE-20 Background and Description

The VES-SFE-20 includes the VES-SFE-20 tank, tank vault, access tunnel, associated pump pit, and the CPP-642 compressor building with related piping and instrumentation. Figure 1-4 shows an isometric view of the tank and its vault. The VES-SFE-20 hot waste tank system, including the CPP-642 pump house, was constructed in 1957 to collect low-level liquid waste from the south basin area of CPP-603 and the Fuel Receiving and Storage Area. Construction of the south basin addition, which includes the Fuel Element Cutting Facility (FECF), was also completed in 1957. The addition was to receive, store, and cut aluminum-clad fuel from the test reactor program at Savannah River.



Isometric view of tank vault and pump pit.

Figure 1-4. Isometric view of the tank vault and pump pit.

Floor drains in the receiving area, decontamination pad, and FECF-collected decontamination solutions may have received liquids from the shipping casks and other hot waste liquids. Liquid waste flowed by gravity through underground lines to the VES-SFE-20 tank. From the VES-SFE-20 tank, the liquid waste was pumped to WL-102, a holding tank at the Process Equipment Waste (PEW) Evaporator Facility. When FECF fuel-cutting operations concluded, acid was added to the VES-SFE-20 tank, and the contents were heated to dissolve the fine cuttings that passed through the strainer in the FECF drains. The tank contents were then flushed to the PEW Evaporator Facility.

The VES-SFE-20 tank is located about 20 ft beneath CPP-642. The tank and contents, tank vault, and pump pit were previously part of Operable Unit (OU) 3-09 and are identified as a "Comprehensive Environmental, Response, Compensation and Liability Act (CERCLA)" (42 USC § 9601 et seq., 1980) site (CPP-69), but this project was not sampled under the OU 3-09 Track 2 investigation. Past characterization activities show surface contamination is present in the access tunnel to the pump pit; radioactively contaminated liquid and sediments are present in the tank and on the floor of the tank vault.

Based on historical information, the lines that fed the VES-SFE-20 tank and transferred the waste to the PEW Evaporator Facility were isolated from this tank and incorporated into other tank systems when using the VES-SFE-20 tank was discontinued in 1976. What remains of the tank system will be removed as part of the remedial action described in the *Final Record of Decision, Idaho Nuclear Technology and Engineering Center, Operable Unit 3-13* (DOE-ID 1999).

The CPP-642 building is currently being used to house an air compressor no longer in operation. Utilities and transfer lines supporting adjacent waste holding tanks are routed through CPP-642 above the tank vault and access tunnel. Existing characterization data are further described in *Characterization Work Plan for the VES-SFE-20 Hot Waste Tank at INTEC* (DOE-ID 2003a).

1.5 Scope of Work for the VES-SFE-20 Remedial Action

The selected alternative for VES-SFE-20 includes tank removal, characterization, treatment, and disposal of the tank and its contents, ancillary equipment, and structures. The scope of this HASP is focused on the following:

- Removal of the tank
- Characterization of the tank contents
- Disposal of the soil
- Characterization of the tank, piping, piping insulation, structures, debris, and associated waste.
- The tank and contents will be shipped off-Site for treatment following characterization.

The following sections identify work elements required to implement and complete the VES-SFE-20 Phase I and II remediation. Phase I will consist of remediation of the VES-SFE-20 tank and characterization of the tank contents. Phase II will address the remedial actions associated with the process equipment, structures, and contaminated soils. The extent of soil contamination in the vicinity of VES-SFE-20 and CPP-642 will be determined following removal of the structures. Utilities and wells in the area will affect the excavation and sampling efforts and extent of soil removal. Additionally, field sampling and screening will be conducted throughout Phase I and II activities to determine the disposition path for waste materials as described in the *Waste Management Plan for the VES-SFE-20 Hot Waste Tank System* (DOE-ID 2003b).

1.5.1 Phase I Activities

Phase I characterization activities of the VES-SFE-20 hot waste tank system will include excavating and removing the tank, characterizing the tank contents through sampling activities, rerouting active utility lines, cutting and capping abandoned utility lines, performing asbestos abatement activities, removing loose surface contamination and liquid from the vault and pump pit, disposing of the tank and sediment, and closing the vault and excavation.

1.5.1.1 Mobilization. Mobilization will include setting up work zones and the lay down area, moving required equipment to the project site, and obtaining necessary work authorization and permits. Coordination between VES-SFE-20 Project personnel and INTEC operations will be implemented during the course of Phase I and II activities to minimize the impact of the VES-SFE-20 Project on INTEC operations.

1.5.1.2 Remediation of Tank and Contents. The VES-SFE-20 tank and contents will be removed in Phase I of the remedial action. This section discusses work elements required to complete this initial phase of the remedial action. Phase I work elements include (1) rerouting active utility lines identified in the design, (2) removing presumed asbestos-containing materials (e.g., pipe insulation), (3) performing excavation activities, (4) removing surface contamination on vault surfaces from the tank, (5) disposing of the tank and sediment, and (6) completing temporary closure of the vault and excavation.

1.5.1.3 Rerouting of Existing Utilities. Past operations in the immediate area around the VES-SFE-20 tank used electrical, steam, water, and other process lines. These utility lines are either active and in use supporting existing INTEC operations or are inactive and abandoned. The active or abandoned lines within the excavation zone or within the VES-SFE-20 tank vault are identified in applicable company documents and procedures. Inactive lines will be cut and capped in accordance with the design called out in applicable company documents and procedures. Active lines identified in Engineering Design File (EDF) -3282, "VES-SFE-20 Hot Waste Tank Retrieval and Demolition Structural Design," will be rerouted to support current operations. Phase I excavation activities will require demolition of one abandoned "Resource Conservation and Recovery Act" (42 USC § 6901 et seq., 1976) (RCRA) process line, and cutting and capping of this line. Waste generated from demolition of the RCRA line will be managed as CERCLA waste and will be disposed of in the INEEL CERCLA Disposal Facility (ICDF). If lines are active, using a vacuum excavator may be warranted in compliance with applicable company policies and procedures.

During Phase I, all electrical devices inside CPP-642 will be abandoned in place, and active electrical services to CPP-648 and -1677 will be rerouted. Building CPP-642 currently acts as a hub for the electrical power and control systems for CPP-1677 and -648. The excavation around CPP-642 during Phase I, and the demolition of CPP-642 during Phase II, will require new power and control system circuits to be installed for CPP-1677 and -648 to remain in operation. During Phase I, all electrical devices inside CPP-642 will be abandoned in place, and electrical services to CPP-648 and -1677 will be rerouted; therefore, no further actions will be necessary in Phase II. A new electrical duct bank and conductors will be installed from CPP-603 to CPP-1677 and from CPP-1677 to CPP-648. This new duct bank will be installed outside the boundary of the anticipated excavation. These new circuits will provide power and communications to the various electrical devices in these two buildings.

Abandoned lines within the remedial work zone will be located, removed, capped, or rerouted as called out in the Phase 1 construction drawings in the *Remedial Design/Remedial Action Work Plan for the VES-SFE-20 Hot Waste Tank System* (DOE-ID 2003c). One active high-pressure air line (HAA-104797) will be cut and rerouted into the high-pressure line (HAA-105541) to support current operations in CPP-648 and also to clear the Phase I and II excavation boundaries.

When utility lines are encountered that are not indicated on the drawings, the contractor representative shall be notified before further work in that area is performed. Generated waste will be managed as CERCLA waste in accordance with the Waste Management Plan (WMP) (DOE-ID 2003b).

1.5.1.4 Excavation, Sloping, and Soil Disposal. Phase I excavation will consist of a sloped excavation to expose the roof of the VES-SFE-20 vault. The vault roof is approximately 10 ft below surface grade. The excavation will extend 1 ft below the surface of the vault roof to gain access required

to cut and remove the roof. Phase I excavation drawings can be found in applicable company documents and procedures. Approximately 355 yd^3 of soil will be removed during the Phase I excavation. The soil removed during Phase I will be stockpiled adjacent to the excavation and will be returned to the pit following tank removal and replacement of the vault roof. A standard liner will be placed below the pile and a cover used over the soil pile for fugitive dust control. Excavated soil that poses a radiological risk will be disposed of at the ICDF. Remaining soils will be returned to the excavation. Details about this potential waste stream can be found in the WMP. Standard dust-control measures will be employed during all activities involving earthwork.

1.5.1.5 Containment Tent. Upon completion of excavation activities, a containment tent with removable top will be erected over the vault. The tent will serve a dual purpose as a radioactive contamination containment and asbestos-particle containment during asbestos-abatement activities. The enclosure will be designed to operate under negative pressure with high-efficiency particulate air (HEPA) filtration for containment and control of asbestos and radioactive contamination. Ancillary equipment for the remediation activities will be stored within the enclosure as space is available.

1.5.1.6 Contaminant Fixation. Before removal of the vault roof, holes will be core-drilled through the 8-in. concrete roof and a coating of paint will be spray-applied as a contamination control measure to encapsulate and fix any loose radiological and asbestos contamination. All paint will be applied in accordance with the manufacturer instructions using the necessary tools, extensions, sprayers, and nozzles. The paint will coat all surfaces and objects within the vault (excluding the access tunnel). This will be verified by visual inspection through the access holes using remote examination tools (e.g., cameras). Additional paint may be required at this time to complete the coating process. The fixative paint will be an acrylic-Latex enamel.

1.5.1.7 Removal of Vault Roof. Following fixation of contamination inside the vault, the vault roof will be cut and removed. The roof will be removed by saw cutting with a wet method down to 1/2 to 1 in. of the roof depth. Then a dry cutting method will saw through the last section. During the wet cutting operation, the coolant water will be captured and recycled. Water usage will be controlled during the saw cutting operation to prevent water from entering the vault and flooding the work area. After half the cuts have been made a temporary support beam will be added to the center of the roof slab for support during the remaining cutting process. Two support beams will be added for use as rigging spreader beams. The vault roof will be lifted off the structure using an overhead crane. The vault roof will be disposed of in accordance with the WMP.

1.5.1.8 Cutting and Capping Existing Lines within the Tank Vault. Before extracting the tank, the lines leading to the tank will be cut and capped where they enter the vault, and the flanges will be removed at the tank. Blind flanges will then be installed on the tank ports. The lines will be further cut, if necessary, for disposal purposes. Inactive lines running through the access tunnel, pump pit, and CPP-642 will also be removed. Precautions will be made when cutting, removing, or managing piping to containerize any liquids that may be present. Precautions may include, but will not be limited to, placing a container or impermeable barrier (e.g., Hypalon) beneath the pipe to capture potential liquids that might be released. Following absorption of the liquids, all the remediation waste will be characterized as required by the WMP.

1.5.1.9 Asbestos Abatement. Asbestos abatement will consist of removing asbestos or asbestos-containing material (ACM) associated with Phase I activities and controlling the spread of asbestos fibers and contamination to surrounding facilities, the environment, or personnel resulting from subcontractor activities. Work includes, but is not limited to, providing isolation, barriers, or other means to control the spread of asbestos and removing and disposing of asbestos or ACM as identified on the drawings in the Remedial Design/Remedial Action Work Plan (DOE-ID 2003c).

As ACM is removed, it will be containerized in accordance with asbestos requirements, the waste acceptance criteria of the disposal facility, and the WMP.

Cleanup of all surfaces in the work area and any other contaminated areas will be performed with wet cleaning methods or with HEPA vacuum equipment. All equipment used in the work area will be removed through the decontamination enclosure system, if required, at an appropriate time during the cleaning sequence.

After cleaning, a visual inspection will be conducted in accordance with guidelines from the "Practice for Visual Inspection of Asbestos Abatement Projects" (ASTM E1368). This will be followed, as needed, by application of a lockdown encapsulant to the polyethylene sheeting and all surfaces that have had ACM removed. Any HEPA filtration systems and decontamination systems will remain in service.

1.5.1.10 Removal of Tank and Contents. Following excavation to expose the vault, the concrete vault roof will be cut and removed. The vault roof will be disposed of as debris in the ICDF landfill. Before removal of the roof, access holes will be drilled to accommodate spray application of a fixative material (e.g., Latex paint) to the inner surfaces of the vault as a contamination control measure. A contamination control enclosure with a removable top will be used during removal of the vault roof and will be opened as needed to allow extraction of the tank and associated piping. Before extraction of the tank, lines leading to the tank will be cut where they enter the vault, and the flanges will be removed. Blind flanges with lifting lugs will be used to reseal the openings and also to aid in rigging the tank for removal.

The VES-SFE 20 tank contains approximately 30 to 40 gal of contaminated sediment. This sediment will not be removed separately, but will be sealed in the tank and removed in one step with the tank. Details of the vault opening, ancillary line cutting and capping within the vault, and hoisting and rigging (H&R) of the tank and contents for removal can be found in the Remedial Design/Remedial Action (DOE-ID 2003c).

1.5.1.11 Hoisting Tank from Vault. The tank will be removed through space in the roof of the concrete vault, and this effort will require tilting the tank during the lift. An approximate 40-degree angle will allow the tank to pass through the vault opening. The concrete vault in which the tank sets provides little clearance on the sides and ends; thus, the rigging fixtures must be attached from the top of the tank to provide the best control during the angled lift. Two cranes will be used and attached to the rigging fixture to control the tilted lift. This is considered a critical lift due to the complexity and specific skill level required to accomplish a two-crane lift. An engineering design file was prepared detailing the lift points and rigging design (EDF-3282). A detailed engineering lift plan will be developed with meticulous planning. The two-crane lift will be completed in compliance with MCP-6504, "Hoisting and Rigging Lift Determination and Lift Plan Preparation"; Appendix E, "Multiple Crane Lifts."

1.5.1.12 Surface Contamination Removal and Remaining Surface Contamination Fixation. Removal of large, loose, or visible contamination from the vault floor and pump pit floor will be performed following removal of the tank and identified piping. Cleanup activities on the vault floor will remove all sediment fixed in-place by the paint fixative applied before tank removal. Shovels and scrapers, or similar tools, will be required for removing contamination and sediment. Before contamination removal from within the pump pit, all liquid (if present) will be absorbed, containerized, and characterized.

Following contamination-removal operations, a visual inspection will be performed in the area to determine whether all contamination has been removed. A second application of fixative material will be

applied to the interior surfaces of the vault, as needed, before placement of a precast cement roof. Contamination left in place will be appropriately documented. Loose contamination will be disposed of in accordance with the WMP. Contamination left in place for removal in Phase II will be appropriately documented.

A final coating of paint shall be applied to the remaining vault concrete walls, floor, and roof. The final coating will provide an overall accumulated dry film thickness of 2 mils.

1.5.1.13 Disposal of Tank and Contents. The crane will lift the tank and place it in a designed holding vessel for further characterization and transportation. Once characterization activities are complete, the tank will be placed onto an appropriate transportation vessel. Once on the transportation vessel, the vessel will be closed and secured for shipment off-Site to a treatment and disposal facility. (Note: The configuration of the storage and transportation vessel were unknown at the time this document was written.) The off-Site facility is subject to complying with requirements of 40 CFR 300.440, "Procedures for Planning and Implementing Offsite Response Actions."

The following anticipated waste streams are expected to result from this remedial action:

- The VES-SFE-20 tank containing approximately 33 gal of contaminated sediment
- Ancillary piping
- Contaminated sediment
- Contaminated soil
- Miscellaneous supplies resulting from removal of surface contamination on vault surfaces
- Asbestos debris from asbestos abatement activities.

The tank contains a radioactive heel. If the heel will not be removed but is to remain with the tank structure for disposal, then the mass of the tank structure and the heel may be added together to determine radionuclide concentrations in the waste. The void spaces must be eliminated (e.g., crush or grout the tank) before the waste is disposed of. If the heel is to be removed separately, then the heel must be classified separately from the tank structure. Detailed calculations supporting the concentration levels of TRU contaminants for each waste package are contained in EDF-3273, "TRU Constituent Calculations and the Proposed Disposal Path for the VES-SFE-20 Hot Waste Tank and Contents."

1.5.1.14 Temporary Vault Closure, Backfilling, and Site Grading. A lapse of time is anticipated before Phase II of the project will be implemented. To keep water out of the vault and return the area to a safe condition, a temporary roof made of precast concrete will be placed over the vault, and the excavation will be backfilled and compacted. The precast temporary roof will be sealed to the vault with a joint sealant material to prevent moisture infiltration.

Concentrated dumping of backfill or fill material into excavations is not permitted. No water will be used for placing, settling, or compacting backfill or fill except to obtain optimum moisture content. All material must be placed in uniform layers not to exceed 8 in. deep (loose measurement) and brought up simultaneously and evenly on both sides of foundation walls and around underground or covered structures and equipment (e.g., culverts, manholes, storage tanks, and pipe). Backfill or fill around piping, and at least 4 in. over, will be hand-placed and compacted before pressure testing. Pipe joints shall be left exposed until leak testing has been completed.

Unless otherwise indicated, all backfill and fill material will be compacted to a minimum 4-in. compacted depth above all piping in trenches. Unless otherwise indicated, all compacted backfill or fill shall be compacted to at least 95% of maximum density at optimum moisture content as determined by "Standard Method of Test for the Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop HM-22; Part IIA" (AASHTO 2001). Unless otherwise noted, loose measurement lifts shall be 8 in. maximum. Each lift shall be compacted before the next lift is placed thereon. No heavy equipment shall be allowed within 5 ft of a structure or the foundation of any structure or allowed over piping until a minimum of 24 in. of backfill has been compacted over the piping.

The backfill material will be soils removed and stockpiled during the initial excavation. Soil designated for reuse will be applied to the surface if required to return the site to its preremediation state. Contouring and grading of backfill excavations will be performed to maintain existing surface-water flow patterns at the remediation site. Because this remediation will not affect any vegetated areas, no seeding or vegetation activities will be required. Gravel fill will be replaced to return the site to its preremediation state.

1.5.2 Phase II Activities

Phase II will include remediation of the remaining process equipment and contaminated soil and demolition and removal of remaining related structures. This section provides work elements required to complete the Phase II remediation activities.

1.5.2.1 Cutting and Capping of Existing Utility Lines. Existing utility lines in CPP-642 include active air and power distribution to CPP-1677 (VES-SFE-126) and CPP-648 (VES-SFE-106). All active systems were rerouted during Phase I. However, numerous abandoned process lines cross through the area and pose interference for shoring systems and excavation equipment. These lines will be identified, cut, and capped, as appropriate, at the excavation area boundary.

A concrete pipe corridor containing utilities that support CPP-648 (VES-SFE-106) is situated directly north of the VES-SFE-20 vault. This corridor is attached to the VES-SFE-20 vault roof and the northwest corner of the CPP-642 pump house, and a portion of the corridor is situated directly above the north end of the VES-SFE-20 vault. In addition, abandoned sample lines running from the CPP-648 pump house and entering the north side of the VES-SFE-20 vault are located beneath this corridor. Thus, a portion of the pipe corridor (up to the building line of CPP-648) and the abandoned lines running below the corridor will require removal with the VES-SFE-20 tank vault. Neat lines will be cut around the perimeter of the area of concrete corridor to be removed. The neat lines will be a saw cut score at least 1 in. deep in floors and at least 1 in. deep on both sides of walls. The remaining depth of the concrete at the score lines and the concrete to be replaced will be broken by approved methods. The portion of the facility to remain shall be protected against damage during removal of the pipe corridor.

When utility lines are encountered that are not indicated on the drawings, the contractor's representative shall be notified before further work in that area is performed. Waste generated will be managed as CERCLA waste in accordance with the WMP.

1.5.2.2 Excavation and Shoring. Phase II excavation will consist of a shored excavation that is assumed to extend to basalt. Shoring is required due to the numerous existing structures in the area and the overall depth of the excavation. The bottom of the tank vault is deeper than 20 ft below grade. An excavation boundary was selected such that shoring operations must be contained within that boundary. This boundary was used to generate the volumetric quantities for Phase II. The Phase II excavation will consist of approximately 1,620 yd^3 of soil. The subcontractor will be responsible for developing the shoring design.

1.5.2.3 Asbestos Abatement. Asbestos abatement will consist of removing ACM from the roof of CPP-642 and the pipe corridor. Work includes, but is not limited to, providing isolation, barriers, or other means to control the spread of asbestos and removing and disposing of asbestos or ACM as identified in the drawings.

1.5.2.4 Building Removal. This phase of the VES-SFE-20 remediation includes removal of CPP-642 with related piping and instrumentation. Aboveground building removal will consist of demolishing CPP-642, which is a single-story, 13-ft 4-in. × 9-ft 4-in. structure constructed of 6-in. concrete block walls with a steel-framed, metal-deck roof. Interior components of the building will be disconnected and removed first, and then the structure will be demolished and the rubble removed and disposed of at the ICDF.

1.5.2.5 Underground Structure Removal. The underground structure consists of the VES-SFE-20 tank vault, access tunnel, and the CPP-642 foundation. These structures will be demolished in place and removed from the excavation. The below-grade structures comprising the VES-SFE-20 tank system will be demolished and removed using conventional demolition equipment and methods. These structures include the CPP-642 foundation and pump pit, access tunnel, and tank vault. The existing pipe corridor will be removed up to the building line of CPP-648. These underground structures are constructed of reinforced concrete. Demolition work will commence from the top down with the above-grade structures removed first. Then, as the excavation proceeds, the pump pit, access tunnel, and tank vault will be removed. The existing pipe corridor will be removed by saw-cutting the roof slab, foundation walls, and floor at the building line of CPP-648. A new masonry block wall will be constructed to support the floor slab of CPP-648 and to seal off the below-grade portion of the building. The remaining pipe corridor can then be removed. It is assumed that the contamination levels will allow (1) concrete demolition work to be performed by using excavators and other demolition equipment to break up the concrete into manageable pieces and (2) removal of that concrete waste for disposal at the ICDF.

1.5.2.6 Contaminated Soil Removal. As the concrete structure is removed, the underlying soil will be sampled as directed in the *Field Sampling Plan for the VES-SFE-20 Hot Waste Tank System at INTEC* (DOE-ID 2003d). If found, contaminated soil will be removed. The contaminated soil will only be removed from within the shored area and not "chased" outside the soil and shoring interface. If contaminated soil is found and extends beyond the line of shoring, it will be recorded and later removed as part of the OU 3-13, Group 3, Other Surface Soils, remedial action.

1.5.3 Dust Control

The amount of dust resulting from remedial action activities will be controlled to prevent the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area. Precautions such as water spray, wind monitoring, and visual observation will be used during any earthmoving activities to prevent generation of fugitive dust. An air lance (vacuum excavator) may be used to excavate around or near active or abandoned utility lines to avoid hand excavation and control dust generation.

Precautions such as water spray, wind monitoring, and visual observation will be used during any earthmoving activities to prevent the generation of fugitive dust. Air monitoring may be performed at the discretion of the radiological control technician (RCT) or the industrial hygienist (IH) based on their evaluation of the effectiveness of the dust-suppression measures to control the spread of contamination through fugitive dust. Personal protective equipment (PPE) will be used as specified in Section 5 and as determined by the RCT or IH present at the job site.

Use of water will not be permitted when it will result in or create hazardous or objectionable conditions (e.g., excavation hazards, ice, flooding, and pollution). Air monitoring may be performed at the discretion of the RCT or the IH based on their evaluation of the effectiveness of the dust-suppression measures to control the spread of contamination through fugitive dust. Personal protective equipment, when required, shall be used as specified in Section 5 and as determined by the RCT or IH present at the job site in concert with the project HSO.

1.5.3.1 Disposal of Process Equipment, Structures, and Contaminated Soil.

Contaminated soil from the Phase II remediation activities will be transported directly to ICDF for disposal as discussed in the WMP.

1.5.3.2 Demobilization. Following completion of Phase II remediation activities and decontamination of equipment, the subcontractor will demobilize from the project site. The subcontractor will remove any office trailers and associated ancillary equipment from the site. Temporary fencing and signage, and a decontamination pad, if used, will be removed and disposed of appropriately.

1.6 Other Activities

Additional site activities will be conducted to manage storm water and control dust for eventual site reclamation activities following complete site remediation.

1.6.1 Site Reclamation

Upon completion of Phase II activities, reclamation of the work sites shall be performed, including areas adjacent to any barriers disturbed during construction, lay down areas, and all areas affected by road work and borrow and stockpiling activities. Because this remediation will not affect any vegetated areas, no seeding or vegetation activities will be required. Gravel fill will be replaced to return the site to its preremediation state in accordance with INEEL guidelines.

1.7 Project Interfaces

The "Project Execution Plan for the Idaho Nuclear Technology and Engineering Center, SP 6, Excess Facilities Disposition, D&D" (PLN-804)[a] describes the working relationships for activities and programs conducted at INTEC. Programs at INTEC are being conducted under the regulatory authority of CERCLA; the Final Record of Decision for INTEC OU 3-13 (DOE-ID 1999); and the *Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory* (DOE-ID 1991).

All VES-SFE-20 Project activities will be conducted in accordance with the project auditable safety analysis, this HASP, applicable company policies and procedures, operating procedures (standard and detailed), and work orders where required. A project work order will be developed before work commencement to include necessary work scope, hazard identification, and hazard mitigation strategies.

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a. PLN-804, 2004, "Project Execution Plan for the Idaho Nuclear Technology and Engineering Center, Subproject 6, Excess Facilities Disposition, D&D (Draft), Rev. 0 Draft B, INEEL, January 2004.

2. HAZARD IDENTIFICATION AND MITIGATION

NOTE: *This project will be conducted using both INEEL contractor and subcontractor personnel. Applicable INEEL-specific safety and health subject matter area requirements mentioned in this document are based on an operations approach.*

Personnel may be exposed to safety hazards and chemical, radiological, and physical agents while conducting VES-SFE-20 remedial activities. Contributors to these potential hazards include waste in VES-SFE-20, chemical and radionuclide-soil contamination (historical detection), and the radiation fields from exposing buried waste from VES-SFE-20. It is imperative to identify and mitigate these hazards to prevent injury or exposure to personnel conducting these activities. The primary objective of this section and Section 3 is to identify existing and anticipated hazards associated with VES-SFE-20 remedial activities and to provide controls to eliminate or mitigate these hazards. These activities include the following:

- Evaluating VES-SFE-20 remedial actions to determine the extent to which potential industrial safety, radiological, nonradiological, and physical hazards may affect project personnel
- Establishing monitoring and sampling required to evaluate exposure and contamination levels, determine action levels to prevent exposures, and provide specific actions to be followed if action levels are reached
- Determining necessary engineering controls, isolation methods, administrative controls, work practices, and (where these measures will not adequately control hazards) PPE to further protect project personnel from hazards.

Danger levels posed to personnel entering work zones by hazards of the VES-SFE-20 site are dependent both on the nature of tasks being performed and on the proximity of personnel to the hazards. Engineering controls will be implemented (whenever possible) along with administrative controls, work practices, and PPE to further mitigate potential exposures and hazards. Formal preplanning (e.g., job walk-down, completion of the hazard profile screening checklist, and prejob briefing checklist), written procedures, JSAs, and other work controls will be developed based on the hazards identified in this HASP, applicable company documents and procedures, work packages, and project-specific conditions. These documents will also specify operational hazard-mitigation measures to follow.

The following subsections describe the chemical, radiological, safety, and environmental hazards that personnel may encounter while conducting VES-SFE-20 remedial activities. Hazard mitigation provided in this section, in combination with other work controls (e.g., technical procedures, work orders, JSA, and applicable company documents and procedures), also will be used where applicable to eliminate or mitigate project hazards in accordance with applicable company documents and procedures.

2.1 Chemical and Radiological Hazards and Mitigation

Past characterization and process knowledge of the VES-SFE-20 tank systems has identified both chemical and radiological contaminants of concern. These contaminants are present in the VES-SFE-20 tank and some piping systems as well as in hazards associated with the exterior tank structures and piping (e.g., asbestos insulation). Additional information from characterization work conducted in February 2003 will need to be evaluated and entered into Tables 2-1 and 2-3 as an update if different information becomes available.

Several tables and a figure are presented in this section that identify potential hazards that may be encountered during project activities based on past sampling and known operational records and present task-based hazard-specific mitigation measures. These include the following:

- Table 2-1, "VES-SFE-20 tank radionuclides and chemicals of concern"
- Figure 2-1, "Radiological readings within the VES-SFE-20 tank vault"
- Table 2-2, "Evaluation of agents that may be encountered at the VES-SFE-20 site"
- Table 2-3, "Summary of project activities, associated hazards, and mitigation."

Routes-of-exposure pathways exist for radiological and nonradiological contaminants that are likely to be encountered during VES-SFE-20 Project activities. Engineering controls, monitoring, training, and work controls will be used to mitigate potential contact and uptake of these hazards; however, the potential for exposure to contaminants still exists. Exposure pathways include those listed below:

- **Inhalation** of radiological and nonradiological contaminated soil or fugitive dusts during Phase I and II tasks and ancillary decontamination tasks. Inhalable or respirable (dependent on the particle aerodynamic diameter) fugitive dusts may have trace amounts of radiological or nonradiological contaminants associated with them, resulting in potential respiratory tract deposition.
- **Skin absorption and contact** with radiological and nonradiological contaminated soil, or tank or debris surfaces during Phase I and II tasks. Radiological and nonradiological contaminants can be absorbed through the skin, resulting in uptake through the skin or skin contamination.
- **Ingestion** of radiological and nonradiological contaminated materials adsorbed to dust particles or waste residues, resulting in potential uptake of contaminants through the gastrointestinal (GI) tract that may result in GI irritation, internal tissue irradiation, and deposition to target organs.
- **Injection** of radiological and nonradiological contaminated materials by a break in the skin or migration through an existing wound, resulting in localized irritation, contamination, uptake of soluble contaminants, and deposition of insoluble contaminants.

Chemical and radiological hazards will be eliminated, isolated, or mitigated to the extent possible during all VES-SFE-20 Project activities. Where such hazards cannot be eliminated or isolated, monitoring for chemical and radiological hazards will be conducted (as described in Section 3) to detect and quantify exposures. Additionally, administrative controls, training, work procedures, and protective equipment will be used to further reduce the likelihood of exposure to these hazards.

The JSAs, radiological work permits (RWPs), and other work control documents will be used in conjunction with this HASP to address specific hazardous operations and radiological conditions. When used, these permits will further detail hold points, specialized PPE, and dosimetry requirements.

2.2 Safety and Physical Hazards and Mitigation

Industrial safety and physical hazards will be encountered while performing VES-SFE-20 Project activities. Section 4.2 provides general safe-work practices that must be followed at all times. The following sections describe specific industrial safety hazards and procedures to be followed to eliminate or minimize potential hazards to project personnel.

Table 2-1. VES-SFE-20 tank contaminants of concern.

Contaminant Type	Potential Contaminant of Concern	Concentration	Possible Source
Metals	Cadmium	Unknown	From racks used to store spent fuel in the basins
	Chromium	Unknown	Dissolution of metal alloys
Volatile organic compounds	Acetone	Unknown	Used for decontamination
	Freon	Unknown	From decontamination
	Methylene chloride	Unknown	Likely ingredient in methychlor used for decontamination
	1,1,1-trichloroethane	Unknown	Found in Oakite Swiff used for decontamination
	Tetrachloroethene	Unknown	Used for decontamination
	Formaldehyde (not required per requester)	Unknown	From the chloride removal system
Nonvolatile organic compounds	Polychlorinated biphenyls	Unknown	Based on process knowledge
Anions	Chlorides Nitrates	Unknown Unknown	Based on process knowledge Based on process knowledge
Acidity	Potential for hydrogen ion (pH)	Unknown	Nitric acid and hydrochloric acid were added to the tank
Radionuclides	Sr-90	9,700 pCi/ml	Previously detected (WINCO 1984)
	Co-60	74.3 pCi/ml	Previously detected (WINCO 1984)
	Cs-134	7.76 pCi/ml	Previously detected (WINCO 1984)
	Cs-137	2,050 pCi/ml	Previously detected (WINCO 1984)
	Eu-152	Unknown	Isotope below detection level in 1984 (WINCO 1984), decay product found in the tank sediments
	Eu-154	Unknown	Isotope below detection level in 1984 (WINCO 1984), decay product found in the tank sediments
	Eu-155	Unknown	Isotope below detection level in 1984 (WINCO 1984), decay product found in the tank sediments
	Sb-125	73.2 pCi/ml	Previously detected (WINCO 1984)
	Pu-238, -239, -240, -241, -242	Unknown	Previously detected (WINCO 1984); individual was not determined
	U-234, -235, -236, -238	Unknown	Previously detected (WINCO 1984); individual isotopes were not determined
	Cm-144	Unknown	Decay product
	Zirconium-95	Unknown	Previously detected in the FECF
	Am-241	Unknown	Decay product of plutonium, found in the sediment of CPP-740

Table 2-1. (continued).

Contaminant Type	Potential Contaminant of Concern	Concentration	Possible Source
	Np-237	Unknown	Decay product
	Cm-242	Unknown	Decay product
	K-40	Unknown	Previously detected in the FECF
	Mg-54	Unknown	Previously detected in the FECF
	Nb-95	Unknown	Previously detected in the FECF
	Ru-106	Unknown	Previously detected in the FECF
	I-129	Unknown	Decay product
	C-14	Unknown	Possible activation product
	Tritium	Unknown	Possible activation product
	Ra-226	Unknown	Decay product
	Tc-99	Unknown	Decay product

FECF = Fuel Element Cutting Facility

2.2.1 Material Handling and Back Strain

Material handling and maneuvering of various pieces of equipment and tools during VES-SFE-20 Project activities could result in employee injury. All lifting and material-handling tasks will be performed in accordance with applicable company documents and procedures. Personnel will not physically lift objects weighing more than 22 kg (50 lb) or 33% of their body weight (whichever is less) alone. Additionally, back strain and ergonomic considerations must be given to material handling and equipment use. Mechanical and hydraulic lifting devices should be used to move materials whenever possible. The IH may conduct ergonomic evaluations during VES-SFE-20 Project activities as deemed appropriate to determine the potential ergonomic hazards and provide recommendations to mitigate these hazards. Applicable requirements from applicable company documents and procedures also will be followed.

2.2.2 Repetitive Motion and Musculoskeletal Disorders

Project operational tasks (e.g., material handling and remediation tasks) may expose personnel to repetitive-motion hazards, undue physical stress, overexertion, awkward postures, or other ergonomic risk factors that may lead to musculoskeletal disorders. Musculoskeletal disorders can cause a number of conditions including pain, numbness, tingling, stiff joints, difficulty moving, muscle loss, and paralysis. The assigned project IH may evaluate project tasks and provide recommendations, as deemed appropriate, to reduce the potential for musculoskeletal disorders in accordance with applicable company documents and procedures.

2.2.3 Working and Walking Surfaces

Slippery work surfaces can increase the likelihood of back injuries, overexertion injuries, slips, and falls. Outdoor project activities present inherent tripping hazards because of uneven surfaces and terrain, sloped soil, and using ladders. Additionally, the potential for slip, trip, and fall hazards will increase during winter months because of ice- and snow-covered surfaces. All personnel will be made aware of tripping hazards that cannot be eliminated. Tripping and slip hazards will be evaluated during the course of the project in accordance with applicable company policies and procedures.

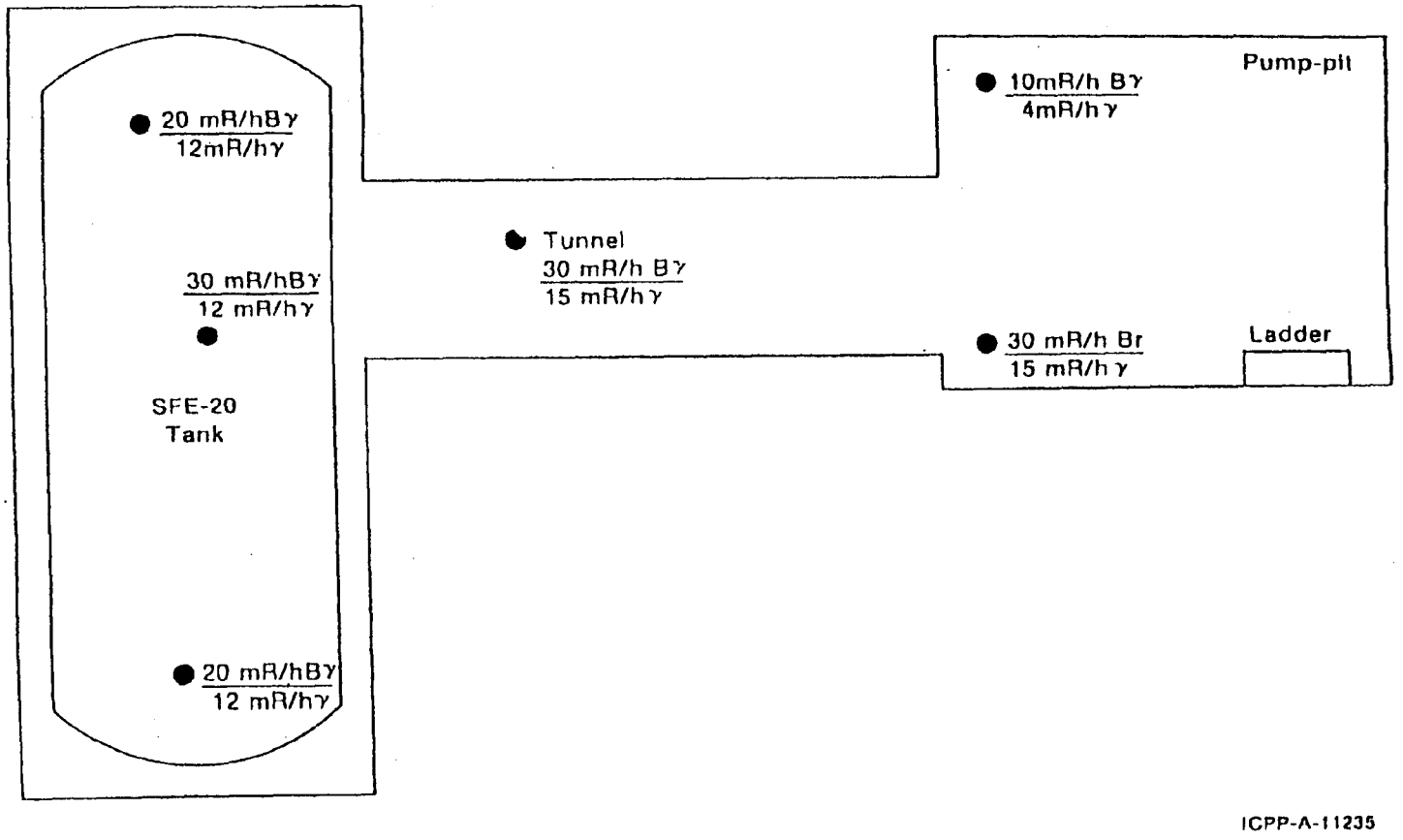

Figure 2-1. Radiological readings within the VES-SFE-20 tank vault (February 1984).

Table 2-2. Evaluation of agents that may be encountered at the VES-SFE-20 Project site.

Material or Chemical (CAS No., vapor density, and ionization energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (acute and chronic)	Target Organs or System	Carcinogen? (source)[e]	Source
Organic Compounds						
Acetone (67-64-1) VD - 2 IE – 9.7 eV	TLV: 500 ppm STEL: 750 ppm	Ih, Ig, Con	Eye, nose and throat irritation; headache; dizziness; CNS depression; dermatitis	Eyes, skin, respiratory system, CNS	No	Unknown, common laboratory cleaning chemical—lab trace contaminant
Diesel fuel (8008-20-6)	TLV: 100 mg/m^3 (as total hydrocarbons)	Ih, Ig, S, Con	Eye irritation; respiratory system changes; dermatitis	Eye, respiratory system	No	Heavy equipment fueling
Diesel exhaust particulate (particulate median cut point aerodynamic diameter 3.5 – 4.0 µm)	TLV: 0.02 mg/m^3 as elemental carbon (ACGIH 2002[b] notice of intended changes)	Ih	Respiratory, nose, throat or lung irritation with stinging and redness of the eyes; headache; nausea; dizziness; unconsciousness	Respiratory system	A2 – ACGIH	Heavy equipment operation
Formaldehyde (50-00-0) VD – 1.56 IE – 10.9 eV Substance-specific standard 29 CFR 1910.1048	TLV: C 0.3 ppm OSHA AL: 0.5 ppm PEL: 0.75 ppm STEL: 2 ppm	Ih, Ig, Con	Irritant to eyes, noise, throat, cough, bronchial spasm, pulmonary irritation	Eyes, skin, respiratory system	A2 - ACGIH	From the chloride removal system
Freon (1,1,1-trichloro-1,2,2-trifluoroethane) (76-13-1) VD – 6.5 IE – 11.99 eV	TLV: 1,000 ppm STEL: 1,250 ppm	Ih, Ig, Con	Irritation skin, throat, drowsiness, dermatitis; central nervous system depression; in animals: cardiac arrhythmias, narcosis	Skin, heart, central nervous system, cardiovascular system	No	From previous decontamination

Table 2-2. (continued).

Material or Chemical (CAS No., vapor density, and ionization energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (acute and chronic)	Target Organs or System	Carcinogen? (source)[e]	Source
Methylene chloride (75-09-2) VD – 1.75 IE – 11.4 eV Substance-specific standard 29 CFR 1910.1052	TLV: 50 ppm OSHA PEL: 25 ppm STEL: 125 ppm	Ih, Ig, S, Con	Eye and skin irritation; fatigue, weakness, somnolence, lightheadedness; numbness, tingle limbs; nausea	Eyes, skin, cardiovascular system, CNS	Yes – NIOSH	Likely ingredient in methychlor used for decontamination
1,1,1-trichloroethane (71-55-6) VD – 4.6 IE – 11.2 eV	TLV: 350 ppm STEL: 450 ppm	Ih, Ig, Con	Eye and skin irritation; headache, lassitude, central nervous system depressant/depression, poor equilibrium; dermatitis; cardiac arrhythmias; liver damage	Eyes, skin, CNS, cardiovascular, liver	No A4 – ACGIH	Found in Oakite Swiff used for decontamination
Tetrachloroethylene (127-18-4) VD – 5.7 IE – 9.3 eV	ACGIH TLV: 25 ppm STEL: 100 ppm PEL: 100 ppm	Ih, Ig, S, Con	Eye, skin, nose, throat, and respiratory system irritation; nausea; flush face, neck; vertigo, dizziness, incoordination; headache, somnolence; skin erythema; liver damage	Eyes, skin, respiratory system, liver, kidneys, CNS	Yes – NIOSH	Used for decontaminat6ion
Aroclor-1260 (potential contaminant only)	TLV not established	Ih, S, Con	Eye irritation, eye inflammation, and swelling of adjoining tissues; GI disturbances; discoloration of the nail and skin; cancer hazard; liver damage; delayed adverse health effects; chloracne	Eyes, GI, skin, liver	Yes – NIOSH	Based on process knowledge—specific polychlorinated biphenyl compound not specified

Table 2-2. (continued).

Material or Chemical (CAS No., vapor density, and ionization energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (acute and chronic)	Target Organs or System	Carcinogen? (source)[e]	Source
Aroclor-1268 (potential contaminant only)	TLV not established	Ih, Ig, S, Con	Chloracne; GI disturbances; eye irritation, inflammation and swelling if the adjoining tissues; discoloration of the nails and skin; liver injury; delayed health effects	Eyes, skin, GI, liver	No	Based on process knowledge – specific polychlorinated biphenyl compound not specified
Inorganic Compounds						
Asbestos (12001-29-5) Substance-specific standard 29 CFR 1910.1001	TLV: 0.2 fiber/cm^3 OSHA PEL: 0.1 fiber/cm^3 Excursion Limit: 1 fiber/cm^3	Ih, Ig, Con	Irritation of eyes and skin, chronic asbestosis, restricted pulmonary function	Eyes/respiratory tract	A1 – ACGIH Yes – NTP Yes – IARC Yes – OSHA	Pipe insulation
Cadmium (7440-43-9) Substance-specific standard 29 CFR 1910.1027	TLV: 0.01 mg/m^3 0.002 mg/m^3 (respirable) OSHA AL: 2.5 $\mu g/m^3$ PEL: 5 $\mu g/m^3$	Ih, Ig	Pulmonary edema, dyspnea, cough, chest tightness, substernal pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; anosmia, emphysema, proteinuria, mild anemia	Respiratory system, kidneys, prostate, blood	Yes – NIOSH	From racks used to store spent fuel in the basins
Chloride (7782-50-5) - chlorine	TLV based on specific chlorine compound	Ih, Ig, Con	General (Cl_2): Burning of eyes, nose, mouth; lacrimation (discharge of tears), rhinorrhea (discharge of thin mucus); cough, choking, substernal (occurring beneath the sternum) pain; nausea, vomiting; headache, dizziness; syncope; pulmonary edema; pneumonitis; hypoxemia (reduced oxygen in the blood); dermatitis	General (Cl_2): eyes, skin, respiratory system	No	Based on process knowledge

Table 2-2. (continued).

Material or Chemical (CAS No., vapor density, and ionization energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (acute and chronic)	Target Organs or System	Carcinogen? (source)[e]	Source
Chromium (7440-47-3)	TLV: Cr-III 0.5 mg/m^3 Soluble Cr-VI 0.05 mg/m^3 Insoluble Cr-VI 0.01 mg/m^3 TWA: 1 mg/m^3	Ih, Ig, Con	Eye and skin irritation; lung fibrosis	Eyes, skin, respiratory system	No	Dissolution of metal alloys
Nitrate/nitrite-N	TLV based on specific compound	No information available	No information available	No information available	No information available	Based on process knowledge
Silica, crystalline (14464-46-1) christobalite	TLV: 0.05 mg/m^3 (respirable fraction) TWA: 10 $mg/m^3/(\%SiO_2 + 2)$	Ih, Con	Cough, dyspnea (breathing difficulty), wheezing; decreased pulmonary function, progressive respiratory symptoms (silicosis); irritation eyes	Eyes, respiratory system	OSHA potential	Cutting concrete
Radionuclides (as listed in Table 2-1)						
Radionuclides (whole body exposure from contaminated tank contents/soil/debris/ hot particle)	ALARA, dose limit-per radiological work permit Posting of radiation areas per applicable company policies and procedures	Whole body	If required, alarming electronic dosimetry used to alert workers to increased gamma radiation fields TLDs for whole body TEDE	Blood-forming cells, GI tract, and rapidly dividing cells	Yes – IARC	VES-SFE-20 hot waste tank contents and associated piping and debris, surrounding soils
Radionuclides (fixed and removable surface contamination)	Posting of contamination areas per applicable company policies and procedures	Ig, Con	Portable contamination instruments, swipes, and personal contamination monitor	GI tract, ionization of internal tissue	Yes – IARC	VES-SFE-20 tank contents, contaminated surfaces, soils, debris, and decontamination waste

Table 2-2. (continued).

Material or Chemical (CAS No., vapor density, and ionization energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (acute and chronic)	Target Organs or System	Carcinogen? (source)[e]	Source
Radionuclides (airborne radioactivity)	ALARA, dose limit, in accordance with a RWP 10% of derived air concentration for specific radionuclide selected (10 CFR 835, "Occupational Radiation Protection") Posting of airborne radioactivity areas in accordance with applicable company policies and procedures	Ih, Ig, broken skin	Alarming continuous air monitors, high counts on portable air samplers and personal air samplers	GI tract, ionization of internal tissue through uptake of radionuclides	Yes	Airborne radioactivity resulting from tank content removal, pipe cutting/removal, and other activities where contamination may be aerosolized

Table 2-2. (continued).

Material or Chemical (CAS No., vapor density, and ionization energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (acute and chronic)	Target Organs or System	Carcinogen? (source)[e]	Source

a. Material safety data sheets for chemicals other than waste are available at the project site.

b. ACGIH 2002 TLV Booklet and OSHA (29 CFR 1910) substance-specific standards.

c. (Ih) inhalation; (Ig) ingestion; (S) skin absorption; (Con) contact hazard.

d. (Nervous system) dizziness, nausea, or lightheadedness; (dermis) rashes, itching, or redness; (respiratory) respiratory effects; (eyes) tearing or irritation.

e. If yes, identify agency and appropriate designation (ACGIH A1 or A2, NIOSH, OSHA, IARC, NTP).

ACGHIH = American Conference of Governmental Industrial Hygienists
AL = OSHA action limit
ALARA = as low as reasonably achievable
CAS = Chemical Abstract Service
CNS = central nervous system
GI = gastrointestinal
IARC = International Agency for Research on Cancer
IH = industrial hygienist
NIOSH = National Institute of Occupational Safety and Health
NTP = National Toxicology Program
OSHA = Occupational Safety and Health Administration
PEL = permissible exposure limit
RCM = radiological control manual
RWP = radiological work permit
TEDE = total effective dose equivalent
TLD = thermoluminescent dosimeter
TLV = threshold-limit value
TWA = time-weighed average

Table 2-3. Summary of project activities, associated hazards, and mitigation.[a]

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
Phase I Tasks - Remediation of Tank and Contents		
Mobilization, demobilization and site reclamation	Equipment movement and vehicle traffic—trailers, forklift, pinch points, and struck-by or caught-between potential.	JSAs, qualified heavy equipment operator, forklift operators, backup alarms on industrial vehicles, designated traffic lanes and areas, watch body position, and wear PPE.
	Lifting and back strain—staging containers and support materials, material movement, installation and removal of fencing and posts, anchoring trailers, lifting and carrying H&R equipment.	Use mechanical lifting and transporting devices, use two-person lifting if object exceeds 50 lb or is awkward, and do not exceed maximum manual lifting limit of 50 lb or 33% of a person's body weight (whichever is less).
	Tripping hazards and working-walking surfaces—uneven surfaces and terrain, ice- and snow-covered surfaces, and truck decks, and ladder use.	Identify potential slip, trip, and fall hazards of project site walking and working surfaces and mitigate or mark where possible; keep working surfaces clear of debris; salt and sand icy areas; move cords and lines out of walkways where feasible; wear required footwear; provide and use ladder training; maintain three-point contact when ascending or descending ladder.
	Overhead hazards—heavy equipment, existing structures.	Identify and mark overhead hazards where practical and wear head protection (e.g., hard hat).
	Heat and cold stress—working outdoors.	IH monitoring as required, PPE, training, work and rest cycles as required, stay times documented on an SWP (or equivalent) as required.
Rerouting of existing utilities and lines	Radiological contamination—process lines and surrounding soil surface. Radiation exposure—pipe content (with a dose rate).	Evaluation of line content in a sequential manner to determine content and potential hazards, RWP (as required), RCT surveys, hold points, shielding (as required), direct-reading instruments, compliance with applicable radiological posting requirements, PPE, and use of dosimetry and survey requirements.

Table 2-3. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Chemical and nonradiological contaminants—waste in process lines and surrounding soil, cutting and capping lines, refueling.	Evaluate line content in a sequential manner to determine content and potential hazards, control pipe effluent during cutting task, use trained fuel handlers, use engineering controls, ensure personnel are positioned upwind during cutting tasks, control access, use area monitors, direct reading instruments, JSAs, MSDS for all chemicals used, and PPE.
	Lifting and back strain—staging new lines and support materials, process line section movement, lifting and carrying H&R equipment.	Use mechanical lifting and transporting devices, perform two-person lifting if object exceeds 50 lb or is awkward, and do not exceed maximum manual lifting limit of 50 lb or 33% of a person's body weight (whichever is less).
	Equipment movement and vehicle traffic—excavator, forklift, and industrial vehicle operations, pinch points, and struck-by or caught-between potential.	JSAs, qualified heavy equipment operator, forklift operators, backup alarms on industrial vehicles, designated traffic lanes and areas, clear swing radius during excavation tasks, body position awareness, wearing high visibility vests, and PPE.
	Stored and live energy sources—electrical, mechanical, thermal, elevated materials, potential pressurized systems, excavator, H&R, rolling vehicles.	Performing outage and/or subsurface investigation to identify and mark all utilities, hand digging around piping, using LO/TO training, performing LO/TO in accordance with applicable company documents and procedures, ensuring all lines and cords are checked for damage, using GFCI on outdoor equipment, comply with minimum clearances for overhead lines, conducting inspections of H&R equipment, set brake and use tire chocks where appropriate, clear swing radius of excavator during operation.
	Tripping hazards and working and walking surfaces—uneven surfaces and terrain, piping, materials and debris, icy, snow-covered, and wet surfaces.	Ensuring awareness of walking surfaces; using established walkways, ramps, and routes; removing debris and materials from walking and working surfaces; salt and sand icy areas; using nonskid or high-fiction materials on walking surfaces; wearing adequate footwear with traction sole.
	Heat and cold stress—working outdoors and tasks requiring use of protective clothing and respiratory protection.	IH monitoring as required, PPE, training, work and rest cycles as required, stay times documented on SWP (or equivalent) as required.

Table 2-3. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Hazardous noise—cutting lines, areas around equipment and when operating some equipment.	Source identification and labeling, IH sound level monitoring and/or dosimetry, isolation, and hearing protection devices.
	Pinch points and cuts or lacerations—cutting and capping lines, threading pipe, and sharp pipe edges or ends.	Identify potential sharp objects, provide temporary caps as necessary to protect sharp ends, use cutting tools with guards, wear required PPE including eye and face protection and leather gloves for all cutting and sharp material handling tasks.
Excavation, sloping, soil disposal, vault top removal	Radiological contamination—potentially contaminated soil. Radiation exposure—hot particles and contamination (with a dose rate).	RCT surveys, hold points, RWP (as required), direct-reading instruments, compliance with applicable radiological posting requirements, PPE, and use of dosimetry and survey requirements.
	Chemical and nonradiological contaminants—potentially contaminated soil, refueling.	Wet excavation areas as necessary to minimize dust, trained fuel handlers, engineering controls, controlled access, position personnel upwind during excavation tasks, area monitors and direct reading instruments, JSAs, MSDS for all chemicals used, and PPE.
	Respirable dust—particulates not otherwise specified.	Wet excavation areas as necessary to minimize dust, use soil cover, conduct baseline and periodic air monitoring to establish exposure levels for affected personnel as deemed appropriate by IH.
	Lifting and back strain—staging soil containers, lifting and carrying liner and other materials/equipment.	Use mechanical lifting and transporting devices, two-person lifting if object exceeds 50 lb or is awkward, do not exceed maximum manual lifting limit of 50 lb or 33% of a person's body weight (whichever is less).
	Equipment movement and vehicle traffic—excavator, forklift, and industrial vehicle operations, pinch points, overhead hazards, and struck-by or caught-between potential, overhead hazards, and suspended loads.	JSAs, qualified heavy equipment operator, forklift operators, backup alarms on industrial vehicles, designated traffic lanes and areas, clear swing radius area during excavation tasks, watch body position, and wear high visibility vests and required PPE.

Table 2-3. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Stored and live energy sources—electrical, mechanical, thermal, elevated materials, potential pressurized systems, excavator, rolling vehicles.	Performing outage and/or subsurface investigation to identify and mark all utilities, hand digging around any piping and roof, using LO/TO training, preparing applicable work packages, using LO/TO in accordance with applicable company documents and procedures, clearing swing radius before initiating excavation tasks, ensuring all lines and cords are checked for damage, using GFCI on outdoor equipment, complying with minimum clearances for overhead lines, setting brake and using tire chocks where appropriate, and wearing high visibility vests and other PPE. A competent person inspects excavation in accordance with applicable company documents and procedures. Barricade excavation from vehicle and equipment traffic where required.
	Tripping hazards and working and walking surfaces—uneven surfaces and terrain, piping, materials and debris, icy, snow-covered, and wet surfaces.	Be aware of walking surfaces; use established walkways, ramps, and routes; remove debris and materials from walking and working surfaces; salt and sand icy areas; use nonskid or high-fiction materials on walking surfaces; and wear adequate footwear with traction sole.
	Heat and cold stress—working outdoors and tasks requiring use of protective clothing and respiratory protection.	IH monitoring as required, PPE, training, work and rest cycles as required, stay times documented on SWP (or equivalent) as required.
	Hazardous noise—areas around equipment and when operating some equipment.	Source identification and labeling, IH sound-level monitoring and/or dosimetry, isolation, and hearing protection devices.
Removal of tank and contents	Radiological contamination—tank/piping surface, vault area, and waste contents. Radiation exposure—waste or contamination surfaces (with a dose rate).	Fixative spray to fix contamination, HEPA-filtered vacuum for cleaning vault debris, RCT surveys, hold points, RWP, direct-reading instruments, compliance with applicable radiological posting requirements, PPE, and use of dosimetry and survey requirements.

Table 2-3. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Chemical and nonradiological contaminants—waste in tank/pipes, asbestos on piping, silica from concrete drilling/cutting, refueling, spray fixative compound.	Trained fuel handlers, engineering controls, controlled access, area monitors and direct reading instruments, JSAs, wet concrete sawing method, personal air monitoring for silica (as deemed appropriate by IH), MSDS for all chemicals used, remote applicator for spraying fixative material, monitoring, and wear PPE. Conduct all asbestos abatement tasks in accordance with 29 CFR 1910.1001 or 29 CFR 1926.1101, "Asbestos," and applicable company documents and procedures.
	Lifting and back strain—material movement, staging new flanges and support materials, process line section movement, lifting and carrying piping, H&R equipment.	Use mechanical lifting and transporting devices, use two-person lifting if object exceeds 50 lb or is awkward, and do not exceed maximum manual lifting limit of 50 lb or 33% of a person's body weight (whichever is less).
	Equipment movement, vehicle traffic, H&R—forklift, and industrial vehicle operations, pinch points, and struck-by or caught-between potential, overhead hazards and suspended loads.	JSAs, qualified heavy equipment operator, forklift operators, backup alarms on industrial vehicles, designated traffic lanes and areas, and watch body position. All hoisting and rigging tasks conducted in accordance with applicable company documents and procedures, lift plan, no personnel under suspended load, and PPE requirements.
	Stored and live energy sources—electrical, mechanical, thermal, elevated materials, potentially pressurized systems, and rolling vehicles.	Outage and/or subsurface investigation to identify and mark all utilities, hand digging around piping, LO/TO training, applicable work packages, LO/TO in accordance with applicable company documents and procedures. Ensure all lines and cords are checked for damage, use GFCI on outdoor equipment, comply with minimum clearances for overhead lines, conduct inspections of H&R equipment, and set brake and use tire chocks where appropriate.

Table 2-3. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Tripping hazards and working and walking surfaces—entry into vault area; excavated slopes; cords, lines, and debris; ladder use; uneven surfaces and terrain; icy, snow-covered, and wet surfaces.	Be aware of walking surfaces, clear working and walking surfaces of cords and debris (where feasible), use established ramps, maintain three-point contact with ladder when ascending and descending and ladder training in accordance with applicable company policies and procedures, salt and sand icy areas, use nonskid or high-fiction materials on walking surfaces, and wear adequate footwear with traction sole.
	Heat and cold stress—working outdoors and tasks requiring use of protective clothing and respiratory protection.	IH monitoring as required, PPE, training, work and rest cycles as required, stay times documented on SWP (or equivalent) as required.
	Pinch points and cuts or lacerations—cutting and capping lines, drilling and cutting concrete vault roof, threading pipe, sharp pipe edges and ends, removing and installing new flanges and lifting fixtures.	Identify potential sharp objects, provide temporary caps as necessary to protect sharp ends, use cutting and sawing tools with guards, be aware of body position while using mechanical lifting device to lift and position heavy flanges, ensure no body parts are under suspended load, and wear required PPE including eye and face protection and leather gloves for all tasks requiring cutting and handling sharp material.
	Hazardous noise—drilling and cutting roof and piping, areas around equipment and when operating some equipment.	Source identification and labeling, IH sound-level monitoring and/or dosimetry, isolation, and hearing protection devices.
	Confined space entry—vault area entry.	Review existing and complete confined-space evaluation form; eliminate atmospheric and safety hazards before entry (where feasible); ensure entrants, attendants, and entry supervisor are trained; conduct monitoring of space before entry; and use permit system in accordance with applicable company documents and procedures.

Table 2-3. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
Characterization, disposal of tank and contents	Radiological contamination—tank sediment, piping, soil and debris. Radiation exposure—contamination associated with waste materials and debris (with a dose rate).	Confinement of contaminated materials, minimize direct handling, RCT surveys, shielding (as required), hold points, RWP, direct-reading instruments, compliance with applicable radiological posting requirements, PPE, and use of dosimetry and survey requirements.
	Chemical and nonradiological contaminants—tank sediment, piping, soil, debris, and asbestos.	Isolation of materials with barriers/confining layer, engineering controls, controlled access, area monitors and direct reading instruments, JSAs, MSDS for all chemicals used, and PPE. Conduct all asbestos abatement tasks in accordance with 29 CFR 1910.1001 or 29 CFR 1926.1101, "Asbestos," and applicable company documents and procedures.
	Lifting and back strain—staging waste for removal, containerizing waste; waste container handling, positioning, and movement; and lifting and carrying H&R equipment.	Use mechanical lifting and transporting devices, two-person lifting if object exceeds 50 lb or is awkward, do not exceed maximum manual lifting limit of 50 lb or 33% of a person's body weight (whichever is less).
	Equipment movement and vehicle traffic—forklift, and industrial vehicle operations, pinch points, and struck-by or caught-between potential, suspended load, overhead hazards.	JSAs, qualified heavy equipment operator, forklift operators, backup alarms on industrial vehicles, designated traffic lanes and areas, watch body position, and wear PPE.
	Tripping hazards and working and walking surfaces—open excavation slopes, lines and cords, debris, uneven surfaces and terrain, icy, snow-covered, and wet surfaces.	Awareness of walking surfaces, clear working/walking surfaces of cords and debris (where feasible), use established ramps, salt and sand icy areas, and use nonskid or high-fiction materials on walking surfaces, wear adequate footwear with traction sole.
	Heat and cold stress—working outdoors and tasks requiring use of protective clothing and respiratory protection.	IH monitoring as required, PPE, training, work and rest cycles as required, stay times documented on SWP (or equivalent) as required.
	Hazardous noise—areas around equipment and when operating some equipment.	Source identification and labeling, IH sound level monitoring and/or dosimetry, isolation, and PPE (as required).

Table 2-3. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
Vault closure and site grading	Radiological contamination—fixed contamination on vault surfaces, and potentially surrounding soil. Radiation exposure—contamination (with a dose rate).	RCT surveys, hold points, RWP, direct-reading instruments, compliance with applicable radiological posting requirements, PPE, and use of dosimetry and survey requirements.
	Chemical and nonradiological contaminants—refueling additional fixative as required.	Trained fuel handlers, controlled access, area monitors and direct reading instruments, JSAs, MSDS for all chemicals used, and PPE.
	Lifting and back strain—handling liner on stockpiled soils.	Use mechanical lifting and transporting devices, two-person lifting if object exceeds 50 lb or is awkward, do not exceed maximum manual lifting limit of 50 lb or 33% of a person's body weight (whichever is less).
	Equipment movement, vehicle traffic, excavator swing radius, and hoisting and rigging—forklift, industrial vehicle, crane operations, pinch points, struck-by or caught-between potential, overhead hazards.	JSAs, qualified heavy equipment operator, forklift operators, backup alarms on industrial vehicles, hoisting and rigging in accordance with applicable company policies and procedures, designated traffic lanes and areas, watch body position, clear excavator swing radius, wear high visibility vests, no one under suspended loads, and PPE.
	Tripping hazards and working and walking surfaces—open excavation slopes, lines/cords, debris, uneven surfaces and terrain, icy, snow-covered, and wet surfaces.	Awareness of walking surfaces, clear working/walking surfaces of cords and debris (where feasible), use established ramps, salt and sand icy areas, and use nonskid or high-fiction materials on walking surfaces, wear adequate footwear with traction sole.
	Heat and cold stress—working outdoors.	IH monitoring as required, PPE, training, work and rest cycles as required, stay times documented on SWP (or equivalent) as required.
	Hazardous noise—areas around equipment and when operating some equipment.	Source identification and labeling, IH sound level monitoring and/or dosimetry, isolation, and PPE (as required).

Table 2-3. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
PHASE II TASKS – Remediation of Process Equipment, Structures and Contaminated Soil		
Cutting and capping of existing utility lines	Radiological contamination—process lines and surrounding soil surface. Radiation exposure—pipe content (with a dose rate).	Evaluate line content in a sequential manner to determine content and potential hazards, RWP (as required), RCT surveys, hold points, shielding (as required), direct-reading instruments, compliance with applicable radiological posting requirements, PPE, and use of dosimetry and survey requirements.
	Chemical and nonradiological contaminants—waste in process lines and surrounding soil, cutting/capping lines, refueling.	Evaluate line content in a sequential manner to determine content and potential hazards, control pipe effluent during cutting task, trained fuel handlers, engineering controls, personnel position upwind during cutting tasks, controlled access, area monitors and direct reading instruments, JSAs, MSDS for all chemicals used, and PPE.
	Lifting and back strain—staging new lines and support materials, process line section movement, lifting and carrying hoisting and rigging equipment.	Use mechanical lifting and transporting devices, two-person lifting if object exceeds 50 lb or is awkward, do not exceed maximum manual lifting limit of 50 lb or 33% of a person's body weight (whichever is less).
	Equipment movement and vehicle traffic—excavator, forklift, and industrial vehicle operations, pinch points, and struck-by or caught-between potential.	JSAs, qualified heavy equipment operator, forklift operators, backup alarms on industrial vehicles, designated traffic lanes and areas, clear swing radius during excavation tasks, body position awareness, and wear high visibility vests and PPE.
	Stored and live energy sources—electrical, mechanical, thermal, elevated materials, potential pressurized systems, excavator, H&R, rolling vehicles.	Outage and/or subsurface investigation to identify and mark all utilities, hand digging around piping, LO/TO training, applicable work packages, LO/TO in accordance with applicable company documents and procedures, ensure all lines and cords are checked for damage, use GFCI on outdoor equipment, comply with minimum clearances for overhead lines, conduct inspections of H&R equipment, set brake and use tire chocks where appropriate, clear swing radius of excavator during operation.

Table 2-3. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Tripping hazards and working and walking surfaces—uneven surfaces and terrain, piping, materials and debris, icy, snow-covered, and wet surfaces.	Awareness of walking surfaces, use established walkways/ramps/routes, remove debris and materials from walking/working surfaces, salt and sand icy areas, and use nonskid or high-fiction materials on walking surfaces, wear adequate footwear with traction sole.
	Heat and cold stress—working outdoors and tasks requiring use of protective clothing and respiratory protection.	IH monitoring as required, PPE, training, work and rest cycles as required, stay times documented on SWP (or equivalent) as required.
	Hazardous noise—cutting lines, areas around equipment and when operating some equipment.	Source identification and labeling, IH sound level monitoring and/or dosimetry, isolation, and hearing protection devices.
	Pinch points and cuts or lacerations—cutting and capping lines, threading pipe, sharp pipe edges or ends.	Identify potential sharp objects, provide temporary caps as necessary to protect sharp ends, use cutting tools with guards, wear required PPE including eye and face protection and leather gloves for all cutting and sharp material handling tasks.
Excavation and shoring	Radiological contamination—potentially contaminated soil. Radiation exposure—hot particles and contamination (with a dose rate).	RCT surveys, hold points, RWP (as required), direct-reading instruments, compliance with applicable radiological posting requirements, PPE, and use of dosimetry and survey requirements.
	Chemical and nonradiological contaminants—potentially contaminated soil, refueling.	Wet excavation areas as necessary to minimize dust, trained fuel handlers, engineering controls, controlled access, position personnel upwind during excavation tasks, area monitors and direct reading instruments, JSAs, MSDS for all chemicals used, and PPE.
	Respirable dust—particulates not otherwise specified.	Wet excavation areas as necessary to minimize dust, use soil cover, conduct baseline and periodic air monitoring to establish exposure levels for affected personnel as deemed appropriate by IH.

Table 2-3. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Lifting and back strain—staging soil containers, lifting and carrying materials, and other materials and equipment handling tasks.	Use mechanical lifting and transporting devices, two-person lifting if object exceeds 50 lb or is awkward, do not exceed maximum manual lifting limit of 50 lb or 33% of a person's body weight (whichever is less).
	Equipment movement and vehicle traffic—excavator, forklift, and industrial vehicle operations, pinch points, overhead hazards, and struck-by or caught-between potential.	JSAs, qualified heavy equipment operator, forklift operators, backup alarms on industrial vehicles, designated traffic lanes and areas, clear swing radius area during excavation tasks, watch body position, and wear high visibility vests and required PPE.
	Stored and live energy sources—potential electrical, mechanical, thermal, elevated materials, potential pressurized systems, excavator, rolling vehicles.	Outage and/or subsurface investigation to identify and mark all utilities, hand digging around any piping, LO/TO training, applicable work packages, LO/TO in accordance with applicable company documents and procedures, clear swing radius before initiating excavation tasks, ensure all lines and cords are checked for damage, use GFCI on outdoor equipment, comply with minimum clearances for overhead lines, set brake and use tire chocks where appropriate, wear high visibility vests and other PPE. A competent person inspects excavation in accordance with applicable company documents and procedures. Barricade excavation from vehicle/equipment traffic where required.
	Tripping hazards and working and walking surfaces—uneven surfaces and terrain, piping, materials and debris, icy, snow-covered, and wet surfaces.	Awareness of walking surfaces, use established walkways, ramps, and routes, remove debris and materials from walking/working surfaces, salt and sand icy areas, and use nonskid or high-fiction materials on walking surfaces, wear adequate footwear with traction sole.
	Heat and cold stress—working outdoors and tasks requiring use of protective clothing and respiratory protection.	IH monitoring as required, PPE, training, work and rest cycles as required, stay times documented on SWP (or equivalent) as required.
	Hazardous noise—areas around equipment and when operating some equipment.	Source identification and labeling, IH sound level monitoring and/or dosimetry, isolation, and hearing protection devices.

Table 2-3. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
Building removal	Radiological contamination—potentially fixed contamination on structure. Radiation exposure—hot particles and contamination (with a dose rate).	Isolation of contaminated surfaces, wet excavation areas as necessary to minimize dust, RCT surveys, hold points, RWP (as required), direct-reading instruments, compliance with applicable radiological posting requirements, PPE, and use of dosimetry and survey requirements.
	Chemical and nonradiological contaminants—potentially contaminated soil/surfaces, refueling.	Wet excavation areas as necessary to minimize dust, trained fuel handlers, engineering controls, controlled access, position personnel upwind during excavation tasks, area monitors and direct reading instruments, JSAs, MSDS for all chemicals used, and PPE.
	Respirable dust—particulates not otherwise specified.	Wet excavation areas as necessary to minimize dust, use soil cover, conduct baseline and periodic air monitoring to establish exposure levels for affected personnel as deemed appropriate by IH.
	Lifting and back strain—material handling, lifting and carrying equipment, and other materials and equipment handling tasks.	Use mechanical lifting and transporting devices, two-person lifting if object exceeds 50 lb or is awkward, do not exceed maximum manual lifting limit of 50 lb or 33% of a person's body weight (whichever is less).
	Equipment movement and vehicle traffic—excavator, forklift, and industrial vehicle operations, pinch points, overhead hazards, flying debris, and struck-by or caught-between potential.	JSAs, qualified heavy equipment operator, forklift operators, backup alarms on industrial vehicles, designated traffic lanes and areas, clear swing radius area during excavation tasks, clear area during hydraulic ram operation, closed cab of excavator when conducting demolition activities, watch body position, and wear high visibility vests and required PPE.

Table 2-3. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Stored and live energy sources—potential electrical, mechanical, thermal, elevated materials, potential pressurized systems, excavator, rolling vehicles, open excavation.	Outage and/or subsurface investigation to identify and mark all utilities, hand digging around any piping, LO/TO training, applicable work packages, LO/TO in accordance with applicable company documents and procedures, clear swing radius before initiating excavation tasks, ensure all lines and cords are checked for damage, use GFCI on outdoor equipment, comply with minimum clearances for overhead lines, set brake and use tire chocks where appropriate, wear high visibility vests and other PPE. A competent person inspects excavation in accordance with applicable company documents and procedures. Barricade excavation from vehicle or equipment traffic where required.
	Tripping hazards and working and walking surfaces—uneven surfaces and terrain, piping, materials and debris, icy, snow-covered, and wet surfaces.	Awareness of walking surfaces, use established walkways, ramps, and routes, remove debris and materials from walking/working surfaces, salt and sand icy areas, and use nonskid or high-fiction materials on walking surfaces, wear adequate footwear with traction sole.
	Heat and cold stress—working outdoors and tasks requiring use of protective clothing and respiratory protection.	IH monitoring as required, PPE, training, work and rest cycles as required, stay times documented on SWP (or equivalent) as required.
	Hazardous noise—areas around equipment and when operating some equipment.	Source identification and labeling, IH sound level monitoring and/or dosimetry, isolation, and hearing protection devices.
	Pinch points and cuts or lacerations—debris with sharp edges or ends.	Identify potential sharp objects and avoid contact or handling when feasible, protect sharp ends, wear required PPE including eye and face protection and leather gloves for all material handling tasks.
Underground structure and contaminated soil removal	Radiological contamination—potentially fixed contamination on interior vault surfaces. Radiation exposure—hot particles and contamination (with a dose rate).	Isolation of contaminated surfaces, wet excavation areas as necessary to minimize dust, RCT surveys, hold points, RWP (as required), direct-reading instruments, compliance with applicable radiological posting requirements, PPE, and use of dosimetry and survey requirements.

Table 2-3. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Chemical and nonradiological contaminants—potentially contaminated soil/surfaces, additional fixative, refueling.	Wet excavation areas as necessary to minimize dust, trained fuel handlers, engineering controls, controlled access, position personnel upwind during excavation tasks, area monitors and direct reading instruments, JSAs, MSDS for all chemicals used, and PPE.
	Silica and respirable dust—particulates not otherwise specified.	Wet excavation areas as necessary to minimize dust, use soil cover, conduct baseline and periodic air monitoring to establish exposure levels for affected personnel as deemed appropriate by IH.
	Lifting and back strain—material handling, lifting and carrying soil or waste container liners and other materials/equipment.	Use mechanical lifting and transporting devices, two-person lifting if object exceeds 50 lb or is awkward, do not exceed maximum manual lifting limit of 50 lb or 33% of a person's body weight (whichever is less).
	Equipment movement and vehicle traffic—excavator, forklift, and industrial vehicle operations, pinch points, overhead hazards, flying debris, and struck-by or caught-between potential.	JSAs, qualified heavy equipment operator, forklift operators, backup alarms on industrial vehicles, designated traffic lanes and areas, clear swing radius area during excavation tasks, clear area during hydraulic ram operation, closed cab of excavator when conducting demolition activities, watch body position, and wear high visibility vests and required PPE.
	Stored and live energy sources—potential electrical, mechanical, thermal, elevated materials, potential pressurized systems, excavator, rolling vehicles, open excavation.	Outage and/or subsurface investigation to identify and mark all utilities, hand digging around any piping, LO/TO training, applicable work packages, LO/TO in accordance with applicable company documents and procedures, clear swing radius before initiating excavation tasks, ensure all lines and cords are checked for damage, use GFCI on outdoor equipment, comply with minimum clearances for overhead lines, set brake and use tire chocks where appropriate, wear high visibility vests and other PPE. A competent person inspects excavation in accordance with applicable company documents and procedures. Barricade excavation from vehicle/equipment traffic where required. Professional engineer design approval of excavation protective system if excavation exceeds 20 ft deep.

Table 2-3. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Tripping hazards and working and walking surfaces—uneven surfaces and terrain, piping, materials and debris, icy, snow-covered, and wet surfaces.	Awareness of walking surfaces, use established walkways, ramps, and routes, remove debris and materials from walking/working surfaces, salt and sand icy areas, and use nonskid or high-fiction materials on walking surfaces, wear adequate footwear with traction sole.
	Heat and cold stress—working outdoors and tasks requiring use of protective clothing and respiratory protection.	IH monitoring as required, PPE, training, work and rest cycles as required, stay times documented on SWP (or equivalent) as required.
	Hazardous noise—areas around equipment and when operating some equipment.	Source identification and labeling, IH sound level monitoring and/or dosimetry, isolation, and PPE (as required).
	Pinch points and cuts or lacerations—debris with sharp edges or ends.	Identify potential sharp objects and avoid contact or handling when feasible, protect sharp ends, wear required PPE including eye and face protection and leather gloves for all material handling tasks.
Disposal of process equipment, structures and contaminated soil	Radiological contamination—waste containers. Radiation exposure—associated with contamination (with a dose rate).	RCT surveys, hold points, RWP, direct-reading instruments, compliance with applicable radiological posting requirements, PPE, and use of dosimetry and survey requirements.
	Chemical and nonradiological contaminants—residual waste on debris or containers, refueling.	Controlled access, area monitor and direct reading instruments as required, JSAs, MSDS for all chemicals used, and PPE.
	Lifting and back strain—staging or positioning waste containers support materials, and hoisting and rigging equipment.	Use mechanical lifting and transporting devices, two-person lifting if object exceeds 50 lb or is awkward, do not exceed maximum manual lifting limit of 50 lb or 33% of a person's body weight (whichever is less).
	Equipment movement, vehicle traffic, crane—forklift, and industrial vehicle operations, pinch points, and struck-by or caught-between potential, overhead hazards.	JSAs, qualified heavy equipment operator, forklift operators, backup alarms on industrial vehicles, designated traffic lanes and areas, watch body position, no one allowed under suspended loads, all hoisting and rigging conducted in accordance with applicable company documents and procedures, tie down loads on trailers, and wear PPE.

Table 2-3. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Stored and live energy sources—elevated materials, hoisting and rigging, rolling vehicles.	Hoisting and rigging in accordance with applicable requirements, stack and stage materials and waste in safe configuration, set brake and use tire chocks where appropriate.
	Tripping hazards and working and walking surfaces—uneven surfaces and terrain, ice- and snow-covered, wet surfaces, trailers.	Awareness of walking surfaces, salt and sand icy areas, and use nonskid or high-fiction materials on walking surfaces, wear adequate footwear with traction sole, access trailers using available hand holds and foot platforms.
	Heat and cold stress—working outdoors.	IH monitoring as required, PPE, training, work and rest cycles as required, stay times documented on SWP (or equivalent).
	Hazardous noise—areas around equipment and when operating some equipment.	Source identification and labeling, IH sound level monitoring and/or dosimetry, isolation, and PPE (as required).
Decontamination tasks	Radiological contamination—contact with waste material, contaminated equipment, or components. Radiation exposure—in close proximity to waste containers or contamination with associated dose rate.	RWP, RCT surveys, hold points, direct-reading instruments, collection and counting of swipes, compliance with applicable radiological posting requirements, PPE, use of dosimetry and survey requirements, and ALARA principles (Section 4).
	Chemical and inorganic contaminants—contact with waste material, contaminated equipment, or components.	Controlled areas, JSAs, TPRs or work packages, and PPE.
	Pinch points, struck-by or caught-between—equipment and component movements.	JSAs, TPRs, watch body position, and wearing PPE.
	Lifting and back strain—moving and positioning components.	Use mechanical lifting and transporting devices, two-person lifting if object exceeds 50 lb or is awkward, do not exceed maximum manual lifting limit of 50 lb or 33% of a person's body weight (whichever is less).
	Heat and cold stress—working outdoors and in PPE	IH monitoring as required and work-rest cycles as required.

Table 2-3. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Tripping hazards and working-walking surfaces—uneven surfaces or terrain, icy, snow-covered, and wet or slippery containment surfaces.	Awareness of walking surfaces, salt and sand icy areas, and use nonskid or high-fiction materials on walking surfaces, wear adequate footwear with traction sole, drain standing water through sloping of containment area.
	Electrical—use of electrical equipment or equipment in area where water of wet surfaces are present.	JSA, TPR or work package, use of GFCI outlets or extension cords outdoors and where water or wet surfaces are present, use of barrier material to isolate overspray.

a. All hazards will be identified, evaluated, and controls established in accordance with applicable company policies and procedures requirements. Additionally, project assigned IH, safety professional, and RadCon personnel will be available to assist with the applicable company policies and procedures process and to assist in the development of TPRs, work orders and work packages, and permits associated with VES-SFE-20 Project activities.

ALARA = as low as reasonably achievable
GFCI = ground fault circuit interrupter
H&R = hoisting and rigging
HEPA = high-efficiency particulate air
IH = industrial hygienist
JSA = job safety analysis
LO/TO = lock out and tag out
MSDS = material safety data sheet
PPE = personal protective equipment
RadCon = Radiological Control
RCT = radiological control technician
RWP = radiological work permit
SWP = safe work permit
TPR = technical procedure

2.2.4 Proper Housekeeping to Prevent Slips, Trips, and Falls

Ground surfaces in working areas shall be maintained, so far as possible, in a clean and dry condition. All walking and working surfaces will be kept clean, orderly, and free of foreign objects to prevent possible slip trip, and fall hazards. Proper drainage and use of dry standing stations will be provided where wet processes (e.g., decontamination) are used that could cause a potential slip and fall hazard. All tools and equipment used during each shift will be placed back in the designated storage location unless required to be left in place. Cords and lines will be routed around walkways, stairs, and entrances and exits to eliminate tripping hazards. Elevated walkways, platforms, and working surfaces will be kept clear of potential tripping hazards at all times.

Personnel shall wear appropriate footwear having proper tread for the work to be performed (consider all weather conditions); heavy, durable materials (leather); adequate ankle support; arch support; additional protection as required for the task (e.g., steel toe, steel shank, and metatarsal shock absorption). Footwear can play a role in preventing slips, trips, and falls, Because employees are expected to wear the proper work attire for their respective jobs, they must refrain from wearing slick-bottomed shoes during the months when ice is likely.

2.2.5 Elevated Work Areas

Personnel may sometimes be required to work on elevated structures or equipment at heights 1.8 m (6 ft) above the ground or lower surface. During such work, employees shall be protected from falling by the use of guardrail systems, personal fall-arrest systems, or fall restraint systems (travel restriction system) that prevent personnel from approaching the fall hazard in accordance with applicable company policies and procedures.

Although not anticipated, leading-edge work in areas that will not allow for traditional fall protection controls will require a fall protection plan to be prepared in accordance with applicable company policies and procedures.

2.2.6 Powered Equipment and Tools

Powered equipment and tools used during project activities present potential physical hazards (e.g., pinch points, electrical hazards, flying debris, struck-by, and caught-between) to personnel operating them. All portable equipment and tools will be used for their intended use only and will be properly maintained by qualified individuals in accordance with manufacturer specifications. At no time will safety guards be removed during operation. With proper lock out and tag out (LO/TO), guards may be removed for service and maintenance, then replaced and inspected before operation. Requirements from applicable company policies and procedures will be followed for all work performed with powered equipment including hand tools. The user will inspect all tools before use.

2.2.7 Electrical Hazards and Energized Systems

Electrical equipment and tools, as well as overhead and underground lines associated with project activities, may pose shock or electrocution hazards to personnel. All electrical utilities and lines shall be considered energized until determined to be deenergized by tests or other appropriate methods or means. Ground-fault protected electrical circuits and receptacles, in combination with safety-related work practices, will be employed to prevent electric shock or other injuries resulting from direct or indirect electrical contact. All electrical work will be reviewed and completed under the appropriate work controls (e.g., TPRs or work orders). Before conducting electrical work, hazardous energy of the affected system

will brought to a zero energy state through the use of isolation methods in accordance with the applicable INTEC supplemental procedures for the system or component being worked.

If work on energized systems is necessary, these practices will conform to the requirements in applicable company documents and procedures and Parts I through III of the National Fire Protection Association (NFPA) code, NFPA 70E, "Electrical Safety Requirements for Employee Work Places." Additionally, all electrical and other utilities will be identified before conducting surface penetration maintenance activities in accordance with applicable company documents and procedures.

2.2.8 Fire and Flammable Materials Hazards

Fuel will be required for the excavator and other equipment during project operations. Flammable hazards include transfer and storage of flammable or combustible liquids in the project operations area. Portable fire extinguishers with a minimum rating of 10A/60BC shall be strategically located at the facility to combat Class ABC fires. Portable fire extinguishers will be located in all active project operations areas, on or near all facility equipment that has exhaust heat sources, and on or near all equipment capable of generating ignition or having the potential to spark. When storing project chemicals, applicable company documents and procedures will be consulted to evaluate compatible storage. The applicable requirements will be followed at all times.

2.2.8.1 Combustible Materials. Combustible or ignitable materials in contact with or near exhaust manifolds, catalytic converters, or other ignition sources could result in a fire. The assigned fire protection engineer should be contacted if questions arise about potential ignition sources. Accumulation of combustible materials will be strictly controlled in all project operational areas including the surrounding project and support trailers area. Class A combustibles (e.g., trash, cardboard, rags, wood, and plastic) will be properly disposed of in appropriate waste containers. The fire protection engineer also may conduct periodic site inspections to ensure all fire protection requirements are being met.

2.2.8.2 Flammable and Combustible Liquids. Fuel used at the project for fueling the excavator and generator(s) must be safely stored, handled, and used. Only portable containers approved by Factory Mutual and Underwriters Laboratories (labeled with the contents) will be used to store flammable liquids. All fuel containers will be stored at least 50 ft from any facilities and ignition sources, stored inside an approved flammable storage cabinet or tank meeting the requirement s of NFPA 30, "Flammable and Combustible Liquids Code." Portable motorized equipment (e.g., generators and light plants) will be shut off and allowed to cool in accordance with the manufacturer's operating instructions before being refueled to minimize the potential for a fuel fire.

2.2.8.3 Welding, Cutting, or Grinding. Personnel conducting welding, cutting, or grinding tasks may be exposed to molten metal, slag, and flying debris. Welding, cutting, or grinding on painted surfaces must be conducted under the direction of an IH with the prescribed engineering controls and associated PPE. Additionally, a fire potential exists if combustible materials are not cleared from the work area. Requirements from applicable company policies and procedures will be followed whenever these types of activities are conducted.

2.2.9 Pressurized Systems

Compressor will likely be operated in support of project activities. The hazards presented to personnel, equipment, facilities or the environment because of inadequately designed or improperly operated pressure systems (vessels) include blast effects, shrapnel, fluid jets, equipment damage, personnel injury, and death. These systems can include pneumatic, hydraulic, or compressed-gas systems. The applicable requirements in applicable company policies and procedures and the manufacturer's

operating and maintenance instructions must be followed. This includes inspection, maintenance, and testing of systems and components in conformance with applicable American National Standards Institute (ANSI) requirements.

All pressure systems will be operated in the designed operating pressure range, which is typically 10 to 20% less than the maximum allowable working pressure. Additionally, all hoses, fittings, lines, gauges, and system components will be rated for the system for at least the maximum allowable working pressure (generally the relief set point). The project safety professional should be consulted about any questions of pressure systems in use at the project site.

2.2.10 Compressed Gases

Compressed gases may be used in support of project operations. If used, all cylinders will be used, stored, handled, and labeled in accordance with applicable company policies and procedures. All transportation, handling, storage, and use of compressed-gas cylinders will be conducted in accordance with the Compressed Gas Association pamphlet P-1-2000, "Safe Handling of Compressed Gases" (CGA 2000). Additionally, the assigned project safety professional should be consulted about any compressed gas cylinder storage, transport, and use issues.

2.2.11 Equipment and Industrial Vehicle Hazards

The excavator, industrial vehicles, and forklifts will likely be used to support activities. Hazards associated with operation of the excavator and forklifts include injury to personnel (e.g., struck-by and caught-between hazards), equipment contact with the structures, and property damage. All equipment will be operated in the manner in which it was intended and in accordance with manufacturer instructions or equipment design. Only authorized qualified personnel (e.g., heavy equipment operators) will be allowed to operate heavy equipment. Personnel in proximity to operating equipment must maintain visual communication with the operator and stay out of the equipment swing radius. Personnel also must comply with applicable requirements of the following:

- DOE-STD-1090-2001, Chapter 10, "Forklift Trucks"
- Any applicable company documents and procedures.

Additional safe practices include the following:

- All parked, unattended, heavy equipment will have the bucket or tines in the lowered position (resting on ground).
- All heavy equipment and industrial vehicles will have functioning backup alarms.
- Personnel are prohibited from walking directly behind or to the side of equipment without the operator's knowledge.
- While operating equipment in the work area, the equipment operator will maintain communication with a designated person who will be responsible for providing direct voice contact or approved standard hand signals. In addition, all facility personnel in the immediate work area will be made aware of the equipment operations.
- All equipment will be operated away from established traffic lanes and personnel access ways (whenever possible) and will be stored so as not to endanger personnel at any time.

- All unattended equipment will have appropriate reflectors or be barricaded if left on or adjacent to roadways.

- All parked equipment will have the parking brake set and chocks will be used when equipment is parked on inclines.

- Personnel will be protected from the excavator swing radius. This may be accomplished by any or a combination of the following as determined appropriate by the safety professional and documented in work control documentation: (1) the swing radius area may be barricaded or marked to warn personnel, (2) training personnel on the swing radius and the safe work practices required for the task and work location, or (3) shutting down the excavator when personnel are working inside the swing radius area.

2.2.12 Excavations

Project utility rerouting and other tasks will require excavation activities. All surface penetrations and related outages will be coordinated through the FTL or subcontractor technical representative (STR) and will require submittal of an outage request for outages (e.g., road, electrical, and water). The submission of an outage request will not be considered an approval to start the work. If lines are active, using a vacuum excavator may be warranted in compliance with applicable company documents and procedures.

Other specific outage requirements are addressed in the special conditions section of the management and operating contract.

NOTE: *No surface penetrations will be allowed or conducted until the area has been evaluated and an approved subsurface evaluation has been documented.*

All excavation activities will be conducted and monitored in accordance with applicable company policies and procedures and 29 CFR 1926, Subpart P, "Excavations." A trackhoe may be used for CPP-84 activities. The trackhoe shall not dig closer then 2 ft vertically or 5 ft horizontally from any portion of the compressed gas cylinders. Hand excavation with nonsparking tools may be used during activities less than or equal to 2 ft from any compressed gas cylinder. The project may use an air lance vacuum excavator to remove soils within 2 ft vertically and 5 ft horizontally of buried gas cylinders.

NOTE: *2-5 Rule: Any excavation within 5 ft horizontally or 2 ft vertically of marked underground energized or pressurized cables or piping not present in a concrete ductbank shall be done by hand, unless an exception is granted by the area environment, safety, and health manager to use alternative excavation technology (e.g., vacuum or sonic), as documented on a safe work permit (SWP) or work control document.*

A perimeter barrier will protect the excavation to preclude falls into the excavation or trench. No one shall enter the trench or excavation until it is evaluated as a confined space and proper shoring and sloping or other protective means are provided, in accordance with Program Requirements Documents (PRD) -22 and PRD-2014, "Excavation and Surface Penetration." The following are some key elements from these requirements:

- The location of utility installations (e.g., sewer, telephone, fuel, electric, water lines, or any other underground installations) that may reasonably be expected to be encountered during excavation work will be determined before opening an excavation.

- Structural ramps used solely by employees for access or egress from excavations will be designed by a competent person. Structural ramps used for access or egress of equipment will be designed by a competent person qualified in structural design and will be constructed in accordance with the design. Structural ramps will be inspected in accordance with applicable company forms.

- Walkways shall be provided where employees or equipment are required or permitted to cross over excavations (regardless of height). Guardrails that comply with PRD-5096, "Fall Protection," shall be provided on walkways (29CFR 1926.651[1][l]).

- The excavation competent person is responsible for conducting an inspection after every rainstorm or other hazard-increasing occurrence (29 CFR 1926.651[k]).

- Employees exposed to public vehicular traffic will be provided with and will wear warning vests or other suitable garments marked with or made of reflecting or high-visibility material.

- Daily inspections of excavations, areas adjacent to the excavations, and protective systems will be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection will be conducted by the competent person before the start of work and as needed throughout the shift. Inspections also will be made after every rainstorm or other hazard-increasing occurrence.

- Sloping or benching will be constructed and maintained in accordance with the requirements set forth in 29 CFR 1926, Subpart P, Appendix A, for the soil type as classified by the competent person. This classification of the soil deposits will be made based on the results of at least one visual inspection and at least one manual analysis, or a designation of soil classification Type C may be selected.

- Each contractor employee in an excavation greater than 4 ft deep shall be protected from cave-ins by an adequate protective system.

- Employees shall not be permitted to work on the faces of sloped or benched excavations at levels above other employees except when employees at the lower levels are adequately protected from the hazard of falling, rolling, or sliding material or equipment.

- Protective systems for use in excavations more than 20 ft deep must be designed by a registered professional engineer in accordance with 29 CFR 1926.652(b) and (c).

2.2.13 Surface Penetrations

If the subsurface investigation was not adequate to identify all embedded cables or piping, the following requirements shall be met:

- A shunt (drill stop) shall be used when using an electric drill for core drilling in concrete or when using an electric saw to cut concrete, except in the following instances:

    - Use of double insulated or battery operated motors (this, by no means, precludes the requirements for subsurface investigation).

NOTE: *An external grounding strap is also not required for these types of motors.*

- Core drilling or cutting into cast-in-place concrete surfaces less than 2 in. deep or into precast concrete.

2.2.14 Hoisting and Rigging

Hoisting and rigging will be required to support remedial activities. All hoisting and rigging operations will be performed in accordance with applicable company policies and procedures, and DOE-STD-1090-01, "Hoisting and Rigging," as applicable to project tasks. Project personnel working around or near heavy equipment and other moving machinery will comply with requirements in the following documents:

- MCP-6501, "Hoisting and Rigging Operations"
- MCP-6502, "Hoisting and Rigging Maintenance"
- MCP-6503, "Inspection and Testing of Hoisting and Rigging Equipment"
- MCP-6504, "Hoisting and Rigging Lift Determination and Lift Plan Preparation"
- MCP-6505, "Hoisting and Rigging Training"
- DOE-STD-1090-2001, Chapter 15, "Construction Hoisting and Rigging Equipment Requirements."

Hoisting and rigging equipment will show evidence of a current inspection (e.g., tag) and be inspected before use by designated operators. Additionally, if mobile crane or boom trucks are used to support project tasks, the operator or designated person for mobile cranes or boom trucks will perform a visual inspection each day or before use (if the crane has not been in regular service) of items such as, but not limited to, the following:

- All control mechanisms for maladjustment that would interfere with proper operation
- Crane hooks and latches for deformation, cracks, and wear
- Hydraulic systems for proper oil level
- Lines, tanks, valves, pumps, and other parts of air or hydraulic systems for leakage
- Hoist ropes for kinking, crushing, birdcaging, and corrosion
- All anti-two-block, two-block warning, and two-block damage prevention systems for proper operation.

NOTE: *The equipment operator or other designated person will examine deficiencies and determine whether they constitute a safety hazard. If deficiencies are found, they will be reported to the project safety professional.*

2.2.14.1 Industrial Lift Trucks. Handling and movement of materials and equipment may be conducted using an industrial lift truck of forklift. Lift truck operators shall possess evidence of a lift truck operators training before equipment operation. The following safe practices shall be followed by lift truck operators:

- Ensure operator is familiar with operation of the specific type of lift truck used
- Complete and document lift truck pre-use inspection before use
- Operate equipment only when it is in proper working condition
- Ensure operator remains alert at all times during lift truck operation and yields to pedestrians
- Use lift trucks within rated capacities and intended use
- Center load between the lift truck forks and as close to the fork heels as possible
- Move loads as close to the ground as practical to maintain load stability
- Keep lift truck speed to a minimum to maintain vehicle control at all times
- Transport the load on uphill side of lift truck when the slope is greater than or equal to 10%
- Use the vehicle horn to warn pedestrians, especially near blind corners
- Allow no riders
- Be aware of overhead restrictions
- Look in the direction of travel.

2.2.15 Overhead Hazards

Personnel may be exposed to overhead impact (contact) hazards during project activities from climbing in, between, and around heavy equipment and existing structures. Sources for these hazards will be identified and mitigated in accordance with applicable company policies and procedures. In the case of overhead falling hazards, they will be mitigated by (1) using engineering controls protective systems where there is a potential for falling debris and (2) in combination with head protection PPE.

2.2.16 Decontamination

Decontamination of tank and vault surfaces, powered equipment, tools, and components may be required based on the nature of the remedial activities and extent of contamination. Decontamination procedures for personnel and equipment are detailed in Section 11. Potential hazards to personnel conducting decontamination tasks include back strain; slip, trip, and fall hazards; and cross-contamination from contaminated surfaces. Additionally, electrical hazards may be present if water is used in areas with exposed electrical cords or receptacles. Mitigation of these walking working surfaces and electrical hazards are addressed in prior subsections. If a power washer or heated power washer is used, units will be operated in accordance with manufacturer's operating instructions. Personnel will wear appropriate PPE to prevent high-pressure spray injuries. Ground fault circuit interrupter (GFCI) protection will be used, and tasks will only be conducted in approved areas. Personnel will wear required PPE at all times during decontamination tasks as listed in Section 5 and as listed on the associated JSA and RWP where required.

2.3 Environmental Hazards and Mitigation

Potential environmental hazards to personnel exist during project remedial activities. These hazards will be identified and mitigated to the extent possible. This section describes environmental hazards and states procedural and work practices to be followed to mitigate them.

2.3.1 Noise

Personnel performing project operations activities may be exposed to noise levels that exceed 85 decibel A-weighted (dBA) from the excavator trucks, hand tools, and compressors. A time-weighted average (TWA) of 84 dBA will be applied for a 10-hour work shift. The effects of high sound levels may include the following:

- Personnel being startled, distracted, or fatigued
- Physical damage to the ear and temporary or permanent hearing loss
- Interference with communication that would warn of danger.

Where noise levels are suspected of exceeding 80 dBA, noise measurements will be performed in accordance with applicable company policies and procedures to determine whether personnel exposures are in excess of the applicable TWA (85 dBA for 8 hours of exposure or lower TWA for 10- or 12-hour work-shift exposures).

NOTE: *Exposures exceeding 8 hours per day will be evaluated by the assigned project IH.*

Personnel whose noise exposure routinely meets or exceeds the allowable TWA will be enrolled in the INEEL Occupational Medical Program (OMP) (or subcontractor hearing conservation program as applicable). Personnel working on jobs that have noise exposures greater than 85 dBA will be required to wear hearing protection until noise levels have been evaluated and will continue to wear the hearing protection specified by the IH until directed otherwise. Hearing protection devices will be selected and worn in accordance with applicable company policies and procedures.

2.3.2 Heat and Cold Stress and Ultraviolet Light Hazards

Project tasks will be conducted during times when there is a potential for both heat and cold stress that could present potential hazards to personnel. The assigned IH will be responsible for obtaining meteorological information to determine whether additional heat or cold stress administrative controls are required. All personnel must understand the hazards associated with heat and cold stress and take preventive measures to minimize the effects. Applicable company policy and procedure guidelines will be followed when determining work and rest schedules or when to halt work activities because of temperature extremes.

2.3.2.1 Heat Stress. High ambient air temperatures can result in increased body temperature, heat fatigue, heat exhaustion, or heat stroke that can lead to symptoms ranging from physical discomfort, to unconsciousness, and to death. In addition, operational tasks requiring the use of PPE or respiratory protection prevent the body from cooling. Personnel must inform their supervisor when experiencing any signs or symptoms of heat stress or when observing a fellow employee experiencing such symptoms.

Heat stress stay-times will be documented by the IH on the appropriate work control document(s) (i.e., SWP, prejob briefing form, or other documents) when personnel wear PPE that may increase body heat burden. These stay-times will take into account the amount of time spent on a task, the nature of the

work (i.e., light, moderate, or heavy), type of PPE worn, and ambient work temperatures. Table 2-4 lists heat stress signs and symptoms of exposure.

Individuals showing any of the symptoms of heat exhaustion listed in Table 2-4 shall do the following:

- Stop work
- Exit or be helped from the work area
- Remove and decontaminate PPE (as applicable)
- Move to sheltered area to rest
- Be provided cool drinking water
- Be monitored by a medic or employee certified in cardiopulmonary resuscitation (CPR) and first aid.

Table 2-4. Heat stress signs and symptoms of exposure.

Heat-Related Illness	Signs and Symptoms	Emergency Care
Heat rash	Red skin rash and reduced sweating.	Keep the skin clean, change all clothing daily, and cover affected areas with powder containing cornstarch or with plain cornstarch.
Heat cramps	Severe muscle cramps and exhaustion, sometimes with dizziness or periods of faintness.	Move the patient to a nearby cool place; give the patient half-strength electrolytic fluids; if cramps persist, or if signs that are more serious develop, seek medical attention.
Heat exhaustion	Rapid, shallow breathing; weak pulse; cold, clammy skin; heavy perspiration; total body weakness; dizziness that sometimes leads to unconsciousness.	Move the patient to a nearby cool place, keep the patient at rest, give the patient half-strength electrolytic fluids, treat for shock, and seek medical attention. DO NOT TRY TO ADMINISTER FLUIDS TO AN UNCONSCIOUS PATIENT.
Heat stroke	Deep, then shallow, breathing; rapid, strong pulse, then rapid, weak pulse; dry, hot skin; dilated pupils; loss of consciousness (possible coma); seizures or muscular twitching.	Cool the patient rapidly. Treat for shock. If cold packs or ice bags are available, wrap them and place one bag or pack under each armpit, behind each knee, one in the groin, one on each wrist and ankle, and one on each side of the neck. Seek medical attention as rapidly as possible. Monitor the patient's vital signs constantly. DO NOT ADMINISTER FLUIDS OF ANY KIND.

Monitoring for heat stress conditions shall be performed in accordance with applicable company policies and procedures. Depending on the ambient weather conditions, work conditions, type of PPE worn, and the physical response of work operations personnel, the IH shall inform the FTL, STR, or RCT of necessary adjustments to the work and rest cycle. Additionally, physiological monitoring may be conducted to determine whether personnel are replenishing liquids fast enough. A supply of cool drinking

water will be provided in designated eating areas and consumed only in these areas. Project personnel may periodically be interviewed by the IH, RCT, or safety professional to ensure that the controls are effective and that excessive heat exposure is not occurring. Workers will be encouraged to monitor personal body signs and to take breaks if symptoms of heat stress occur.

NOTE: *Heat exhaustion and heat stroke are extremely serious conditions that can result in death and should be treated as such. The FTL, STR, or HSO should immediately request an ambulance (by calling 777 or 526-1515) be dispatched from the CFA-1612 medical facility, and the individual should be cooled as described in Table 2-4 based on the nature of the heat stress illness.*

2.3.2.2 Low Temperatures and Cold Stress. Personnel will be exposed to low temperatures during fall and winter months or at other times of the year if relatively cool ambient temperatures combine with wet or windy conditions. The IH will be responsible for obtaining meteorological information to determine whether additional cold stress administrative controls are required. Applicable company policies and procedures discuss the hazards and monitoring of cold stress. Table 2-5 provides the cold stress work and warm-up schedule if cold stress conditions exist (e.g., during late fall, winter, early spring).

Additional cold weather hazards may exist from working on snow- or ice-covered surfaces. Slip, fall, and material-handling hazards increase under these conditions. Every effort must be made to ensure walking surfaces are kept clear of ice. The assigned project safety professional should be notified immediately if slip or fall hazards are identified at any project location.

2.3.2.3 Ultraviolet Light Exposure. Personnel will be exposed to ultraviolet light (UV) (sunlight and potential during welding) when conducting project activities. Sunlight is the main source of UV known to damage the skin and to cause skin cancer. The amount of UV exposure depends on the strength of the light, the length of exposure, and whether the skin is protected. No UV rays or suntans are safe. The following mitigative actions may be taken to minimize UV exposure:

- Wear clothing to cover the skin (e.g., long pants [no shorts] and long-sleeve or short-sleeve shirt [no tank tops])
- Use a sunscreen with a sun protection factor of at least 15
- Wear a hat (hard hat where required)
- Wear UV-absorbing safety glasses
- Limit exposure during peak intensity hours of 10 a.m. to 4 p.m. whenever possible
- Select protective clothing and eye protection for welding tasks in accordance with applicable company policies and procedures.

2.3.3 Confined Spaces

Work in confined spaces may subject personnel to risks involving engulfment, entrapment, oxygen deficiency, and toxic or explosive atmospheres. The VES-SFE-20 is configured in such a manner that it is considered a confined space as defined by applicable company policies and procedures. Based on the potential hazards (radiological and asbestos), entries into the vault area will be conducted as permit-required confined space entries, and all requirements of applicable company policies and

Table 2-5. Cold stress work and warmup schedule.

Air Temperature (°F) (approximate)	No Noticeable Wind		Wind 5 mph		Wind 10 mph		Wind 15 mph		Wind 20 mph	
	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks
-15 to -19	Normal breaks	1	Normal breaks	1	75 minutes	2	55 minutes	3	40 minutes	4
-20 to -24	Normal breaks	1	75 minutes	2	55 minutes	3	40 minutes	4	30 minutes	5
-25 to -29	75 minutes	2	55 minutes	3	40 minutes	4	30 minutes	5	Nonemergency work should cease	
-30 to -34	55 minutes	3	40 minutes	4	30 minutes	5	Nonemergency work should cease			
-35 to -39	40 minutes	4	30 minutes	5	Nonemergency work should cease					
-40 to -44	30 minutes	5	Nonemergency work should cease							
-45 and below	Nonemergency work should cease									

procedures will be followed. Other entries will be evaluated by the project IH on a case-by-case basis to determine whether permit-required entry conditions exist.

2.3.4 Biological Hazards

The project area and support structures provide habitat for various rodents, insects, and vectors (i.e., organisms that carry disease-causing microorganisms from one host to another). The potential also exists for encountering nesting materials or other biological hazards and vectors. Hantavirus may be present in the nesting and fecal matter of deer mice. If such materials are disturbed, it can become airborne and create a potential inhalation pathway for the virus. Contact and improper removal of these materials may provide additional inhalation exposure risks.

If suspected rodent nesting or excrement material is encountered, the assigned IH will be notified immediately and **no attempt will be made to remove or to clean the area**. Following an evaluation of the area, disinfection and removal of such material will be conducted in accordance with applicable company policies and procedures.

Snakes, insects, and arachnids (e.g., spiders and ticks) also may be encountered at the project. Common areas to avoid include material stacking and staging areas, under existing structures (e.g., trailers and buildings), under boxes, and other areas that provide shelter. Protective clothing will generally prevent insects from direct contact with the skin. If potentially dangerous snakes or spiders are found or are suspected of being present, warn others, keep clear, and contact the assigned IH for additional guidance as required.

Insect repellant (DEET or equivalent) may be required. Areas where standing water has accumulated (e.g., evaporation ponds) provide breeding grounds for mosquitoes and should be avoided. In cases where a large area of standing water is encountered, it may be necessary to pump the water out of areas other than established ditches and evaporation ponds.

2.3.5 Inclement Weather Conditions

When inclement or adverse weather conditions develop that may pose a threat to persons or property at the project area (e.g., sustained strong winds 25 mph or greater, electrical storms, heavy precipitation, or extreme heat or cold), these conditions will be evaluated and a decision made by the IH, safety professional, RCT, and other operations personnel, as appropriate, to stop work, employ compensatory measures, or proceed with operations. The FTL and project personnel shall comply with applicable company policies and procedures, facility work control documents, and design requirements that specify limits for project activities.

2.4 Other Project Hazards

Project personnel should continually look for potential hazards and immediately inform the FTL, STR, or safety and health personnel of the hazards so that action can be taken to correct the condition. All personnel have the authority to initiate STOP WORK actions in accordance with applicable company policies and procedures if it is perceived that an imminent safety or health hazard exists or to take corrective actions within the scope of the work control authorization documents to correct minor safety or health hazards and then inform the FTL or STR.

Personnel working at the project are responsible to use safe-work practices, report unsafe working conditions, near misses or acts, and exercise good housekeeping habits during project operations with respect to tools, equipment, and waste.

2.5 Site Inspections

The FTL, STR, IH, safety professional, RCT, and operations personnel may participate in project site inspections during the work control preparation stage of the project (e.g., hazard identification and verification walkdowns) and conduct self-assessments or other inspections. Additionally, operations supervisors and assigned health and safety professionals will perform periodic safety inspections in accordance with applicable company policies and procedures.

Targeted or required self-assessments will be performed during project operations in accordance with applicable company policies and procedures as directed by the operations manager or shift supervisor. All inspections and assessments will be documented and available for review by the shift supervisor, as a minimum. Health and safety professionals present during project operations may, at any time, recommend changes in work habits to the shift supervisor. However, all changes that may affect the facility written work control documents (e.g., HASP, JSAs, RWPs, and work orders) must have concurrence from the appropriate operations technical discipline representative onsite, and applicable forms must be prepared for the applicable document as required.